

Ranger™ 305D

For use with machines having Code Numbers: **10926, 11121, 11188, 11275** (Domestic)
11027, 11122, 11189, 11314 (UK)
11039, 11123, 11190, 11315 (EUROPE)

Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.



SERVICE MANUAL

LINCOLN®
ELECTRIC

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⚠️ WARNING

⚠️ CALIFORNIA PROPOSITION 65 WARNINGS ⚠️

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.



FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.



1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.



1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

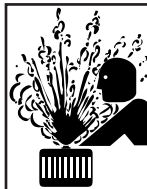
1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.



1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.



1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

Mar '95



ELECTRIC SHOCK can kill.

- 3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
- 3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.
- In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:**
- Semiautomatic DC Constant Voltage (Wire) Welder.
 - DC Manual (Stick) Welder.
 - AC Welder with Reduced Voltage Control.
- 3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.
- 3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.
- 3.e. Ground the work or metal to be welded to a good electrical (earth) ground.
- 3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.
- 3.g. Never dip the electrode in water for cooling.
- 3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
- 3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.
- 3.j. Also see Items 6.c. and 8.



ARC RAYS can burn.

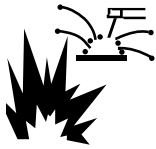
- 4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. 1 standards.
- 4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.
- 4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.



FUMES AND GASES can be dangerous.

- 5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**
5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.
- 5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
- 5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.
- 5.e. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer’s safety practices. MSDS forms are available from your welding distributor or from the manufacturer.
- 5.f. Also see item 1.b.

AUG '06



WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area.

If this is not possible, cover them to prevent the welding sparks from starting a fire.

Remember that welding sparks and hot

materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.

- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Mar '95

PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté spécifiques qui paraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
 - a. Les circuits à l'électrode et à la pièce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
 - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique ou des grilles métalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
 - c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état de fonctionnement.
 - d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
 - e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
 - f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces précautions pour le porte-électrode s'appliquent aussi au pistolet de soudage.
2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas où on reçoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.
3. Un coup d'arc peut être plus sévère qu'un coup de soleil, donc:
 - a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
 - b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
 - c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.
4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.
5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans latéraux dans les

zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.
7. Quand on ne soude pas, poser la pince à un endroit isolé de la masse. Un court-circuit accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaînes de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'échauffement des chaînes et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées toxiques.
10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistelage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgène (gas fortement toxique) ou autres produits irritants.
11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le châssis du poste conformément au code de l'électricité et aux recommandations du fabricant. Le dispositif de montage ou la pièce à souder doit être branché à une bonne mise à la terre.
2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.
3. Avant de faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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INSTALLATION

TECHNICAL SPECIFICATIONS - Ranger 305D (K1727-2) Code 10926, 11121, 11188, 11275

INPUT - DIESEL ENGINE					
Make/Model	Description	Speed (RPM)	Displacement cu. in. (cu. cm.)	Starting System	Capacities
Kubota** D722	3 cylinder 4 stroke 18.8 HP (14 KW) Net intermittent 3600 RPM naturally aspirated water cooled engine	High Idle 3650	43.88(789) Bore x Stroke inch (mm)	12VDC Battery & starter (Group 58; 550 cold crank amps) Battery Charger	Fuel: 12 gal.(45L)
		Full Load 3500	2.64 x 2.68 (67 x 68 mm)		Oil: 3.4Qts. (3.2L)
Low Idle 2450					Radiator Coolant: 3.85Qts. (3.6L)
RATED OUTPUT @ 104° F (40° C) - WELDER					
Welding Process	Welding Output Current/Voltage/Duty Cycle	Output Range		Max. Weld OCV @Rated Load RPM	
DC Constant Current	305A / 29V / 100%	20 TO 305 AMPS		60 Volts	
DC Pipe Current	300A / 29V / 100%	40 TO 300 AMPS			
Touch-Start™ TIG	250A / 30V / 100%	20 TO 250 AMPS			
DC Constant Voltage	300A / 29V / 100%	14 TO 29 VOLTS			
RATED OUTPUT @ 104° F (40° C) - GENERATOR					
Auxiliary Power ¹					
10,000 Watts Peak, / 9,500 Watts Continuous, 60 Hz 120/240 Volts					
Sound Levels					
Sound Power: 104.2 dB Lwa, Sound Level: 80.6 dBA @ 23 ft (7m)					
PHYSICAL DIMENSIONS					
HEIGHT	WIDTH	DEPTH	WEIGHT		
30.00* in. 762.0 mm	21.50 in 546.0 mm	52.25 in. 1327.0 mm	698 lbs. (317kg.)		
ENGINE					
LUBRICATION	EMISSIONS	FUEL SYSTEM		GOVERNOR	
Full Pressure with Full Flow Filter	Certified to EPA Tier I	Electric Fuel Pump (Code 10926, 11121) or Mechanical Fuel Pump (Code 11188, 11275), Auto air bleed system Electric shutoff solenoid Indirect fuel injector		Mechanical Governor	
AIR CLEANER	ENGINE IDLER	MUFFLER	ENGINE PROTECTION		
Single Element	Automatic Idler	Low noise Muffler: Top outlet can be rotated. Made from long life, aluminized steel.	Shutdown on low oil pressure & engine temperature		
ENGINE WARRANTY: 2 year complete (parts and labor) 3rd. year major components (parts and labor)**					
RECEPTACLES AND CIRCUIT BREAKERS					
RECEPTACLES	AUXILIARY POWER CIRCUIT BREAKER		OTHER CIRCUIT BREAKERS		
(2) 120VAC Duplex (5-20R) (1) 120/240VAC Dual Voltage Full KVA (14-50R)	Two 20AMP for Two Duplex Receptacle Two 50AMP for Dual Voltage		25AMP for Battery Charging Circuit 15AMP for 42V Wire Feeder Power		

1. Output rating in watts is equivalent to volt-amperes at unity power factor.
Output voltage is within ± 10% at all loads up to rated capacity. When
welding, available auxiliary power will be reduced.

* Top of enclosure add 6 in. (152mm) for exhaust pipe.

** Engine warranty may vary outside of the USA. (See Engine warranty for
details)

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INSTALLATION

TECHNICAL SPECIFICATIONS - RANGER 305D (CE) K2279-1 (UK) Code 11027, 11122, 11189, 11314 & K2279-2 (EUROPE) Code 11039, 11123, 11190, 11315

INPUT - DIESEL ENGINE					
Make/Model	Description	Speed (RPM)	Displacement cu. in. (cu. cm.)	Starting System	Capacities
Kubota ⁽³⁾ D722	3 cylinder 4 stroke 15.9 HP (12 KW) Net intermittent 3000 RPM naturally aspirated water cooled engine	High Idle 3100	43.88(789) Bore x Stroke inch (mm)	12VDC Battery & starter (Group 58; 550 cold crank amps) Battery Charge	Fuel: 45L (12 US.gal.) Oil: 3.2L(3.4 US. Qts.) Radiator Coolant: 3.6L(3.85 U Qts)
		Full Load 3000	2.64 x 2.68 (67 x 68 mm)		
		Low Idle 2200			

RATED OUTPUT @ 40° C (104° F) - WELDER			
Welding Process	Welding Output Current/Voltage/Duty Cycle	Output Range	Max. Weld OCV @Rated Load RPM
DC Constant Current	250A / 30V / 100%	20 TO 305 AMPS	60 Volts
DC Pipe Current	250A / 30V / 100%	40 TO 300 AMPS	
Touch-Start™ TIG	250A / 20V / 100%	20 TO 250 AMPS	
DC Constant Voltage	250A / 27V / 100%	14 TO 29 VOLTS	

RATED OUTPUT @ 40° C (104° F) - GENERATOR	
Auxiliary Power ⁽¹⁾	Sound Levels
8,500 Watts Peak, / 8,000 Watts Continuous, 50 Hz 115 & 230 Volts - 1 Phase	Sound Power: 98 dB Lwa
8,500 Watts Peak, / 8,000 Watts Continuous, 50 Hz 400 Volts - 3 Phase	

PHYSICAL DIMENSIONS			
HEIGHT	WIDTH	DEPTH	WEIGHT
762mm 30.0 in. ⁽²⁾	546mm 21.50 in.	1524mm 60.0 in.	341kg. (752lbs.)

ENGINE			
LUBRICATION	EMISSIONS	FUEL SYSTEM	GOVERNOR
Full Pressure with Full Flow Filter	Certified to EPA Tier I	Electric Fuel Pump (Code 11027, 11039, 11122, 11123) or Mechanical Fuel Pump (Code 11189, 11190, 11314, 11315), Auto air bleed system Electric shutoff solenoid Indirect fuel injector	Mechanical Governor
AIR CLEANER	ENGINE IDLER	MUFFLER	ENGINE PROTECTION
Single Element	Automatic Idler	Low noise Muffler: Top outlet can be rotated. Made from long life, aluminized steel.	Shutdown on low oil pressure & engine temperature

ENGINE WARRANTY: 2 year complete (parts and labor) 3rd. year major components (parts and labor)⁽³⁾

RECEPTACLES AND CIRCUIT BREAKERS		
MODEL NUMBER	K2279-1 (UK)	K2279-2 (EUROPE)
Receptacles	400V (3 Ph) x 1 230V (1 Ph) x 1 115V x 1 ⁽⁴⁾ 14 Pin Connector 6 Pin Connector	400V (3 Ph) x 1 230V (1 Ph) x 2 14 Pin Connector 6 Pin Connector
Residual Current Device (RCD)	4-pole, 25 Amp (30mA trip current)	4-pole, 25 Amp (30mA trip current)
Circuit Breakers (Thermal/Magnetic)	3 Phase, 20 Amp x 1 1 Phase, 15 Amp x 5	3 Phase, 20 Amp x 1 1 Phase, 15 Amp x 4

(1) Output rating in watts is equivalent to volt-amperes at unity power factor. Output voltage is within ± 10% at all loads up to rated capacity. When welding, available auxiliary power will be reduced.

(2) To top of enclosure, add 152mm (6 ") to top of exhaust elbow.

(3) Engine warranty may vary outside of the USA. (See Engine warranty for details)

(4) Center-Tapped to ground.

RANGER 305D



INSTALLATION

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

⚠ WARNING

Do not attempt to use this equipment until you have thoroughly read the engine manufacturer's manual supplied with your welder. It includes important safety precautions, detailed engine starting, operating and maintenance instructions and parts lists.



ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground
- Always wear dry insulating gloves.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust outside.
- Do not set anything near the engine.



MOVING PARTS can injure.

- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts.

See additional safety information in the front of this manual.

Only qualified personnel should install, use or service this equipment.

LOCATION AND VENTILATION

The welder should be located to provide an unrestricted flow of clean, cool air to the cooling air inlets and to avoid restricting the cooling air outlets. Allow a minimum clearance of 2 feet (0.6m) from the case back and 16in. (406mm) from either side of the base to a vertical surface. Also, locate the welder so that the engine exhaust fumes are properly vented to an outside area.

STORING

1. Store the machine in a cool, dry place when it is not in use. Protect it from dust and dirt. Keep it where it can't be accidentally damaged from construction activities, moving vehicles, and other hazards.
2. If you will be storing the machine for over 30 days, you should drain the coolant from the radiator. Open the cock at the bottom of the radiator and remove the pressure cap so that the coolant drains completely. Attach a note that says "NO WATER" on the radiator.
3. While the engine is still warm, drain the oil and refill with fresh 10W30 oil. Change the oil filter. Run the engine for about five minutes to circulate oil to all the parts. See the **Maintenance** section for details on changing oil.
4. Remove the battery, recharge it, and adjust the electrolyte level. Store the battery in a dry, dark place.
5. If the engine is not used for a long period of time, every two or three months fill the radiator and run the engine for about five minutes to keep it free from rust.

Also see your engine Operator's manual.

Fuel should also be drained when stored for long periods or a fuel additive should be used.

STACKING

Ranger 305D machines CANNOT be stacked.

ANGLE OF OPERATION

Engines are designed to run in the level of condition which is where the optimum performance is achieved. The maximum angle of continuous operation is 20 degrees in all directions. 30 degrees Intermittent (less than 10 minutes continuous) in all directions. If the engine is to be operated at an angle, provisions must be made for checking and maintaining the oil level at the normal (FULL) oil capacity in the crankcase.

When operating the welder at an angle, the effective fuel capacity will be slightly less than the specified 12 gallons (45 ltrs.)

RANGER 305D

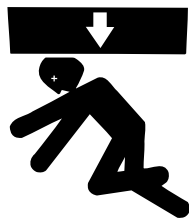


INSTALLATION

LIFTING

The RANGER 305D weighs approximately 775lbs. (352kg.) with a full tank of fuel (698 lbs. less fuel). A lift bail is mounted to the machine and should always be used when lifting the machine

⚠ WARNING



- Lift only with equipment of adequate lifting capacity.
- Be sure machine is stable when lifting.
- Do not lift this machine using lift bail if it is equipped with a heavy accessory such as trailer or gas cylinder.

FALLING EQUIPMENT can cause injury.

- Do not lift machine if lift bail is damaged.
- Do not operate machine while suspended from lift bail.

HIGH ALTITUDE OPERATION

At higher altitudes, output derating may be necessary. For maximum rating, derate the machine 2.5% to 3.5% for every 1000 ft. (305m). Due to new EPA and other local emissions regulations, modifications to the engine for high altitude are restricted within the United States and some European Countries. Use above 6000 ft.(1828 m) may be limited due to poor engine performance or excessive exhaust smoke. An authorized Kubota engine field service shop should be contacted to determine if any adjustments can be made for operation in higher elevations locally.

HIGH TEMPERATURE OPERATION

At temperatures above 104°F(40°C), Welder output derating is necessary. For maximum output ratings, derate the welder output 2 volts for every 50°F(10°C) above 104°F(40°C).

Cold Weather Starting & Operation:

The Kubota engine used in the Ranger 305D can be started in temperatures as low as 5°F (-15°C). At temperatures below 23°F (-5°C) it is recommended that No. 1D diesel fuel is used in place of No. 2D. Allow engine to warm up before applying a load or switching to high idle. Lincoln Electric supplies a Cold Weather Kit if the unit is to be used in Cold Weather Extremes for long periods. See Field Installed options in the **Accessories** section of this manual.

⚠ WARNING

DO NOT USE ETHER OR STARTING FLUID FOR STARTING. SEVERE DAMAGE TO THE ENGINE WILL RESULT.

TOWING

The recommended trailer for use with this equipment for road, in-plant and yard towing by a vehicle¹ is Lincoln's K957-1. (See Accessories Section of this manual for trailer and trailer options). If the user adapts a non-Lincoln trailer, he must assume responsibility that the method of attachment and usage does not result in a safety hazard nor damage the welding equipment. Some of the factors to be considered are as follows:

1. Design capacity of trailer vs. weight of Lincoln equipment and likely additional attachments.
2. Proper support of, and attachment to, the base of the welding equipment so there will be no undue stress to the framework.
3. Proper placement of the equipment on the trailer to insure stability side to side and front to back when being moved and when standing by itself while being operated or serviced.
4. Typical conditions of use, i.e., travel speed; roughness of surface on which the trailer will be operated; environmental conditions; like maintenance.
5. Conformance with federal, state and local laws.¹

¹ Consult applicable federal, state and local laws regarding specific requirements for use on public highways.

VEHICLE MOUNTING

⚠ WARNING

Improperly mounted concentrated loads may cause unstable vehicle handling and tires or other components to fail.

- Only transport this Equipment on serviceable vehicles which are rated and designed for such loads.
- Distribute, balance and secure loads so vehicle is stable under conditions of use.
- Do not exceed maximum rated loads for components such as suspension, axles and tires.
- Mount equipment base to metal bed or frame of vehicle.
- Follow vehicle manufacturer's instructions.

RANGER 305D



INSTALLATION

PRE-OPERATION ENGINE SERVICE

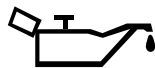
READ the engine operating and maintenance instructions supplied with this machine.

⚠ WARNING

- Keep hands away from the engine muffler or HOT engine parts.
- Stop the engine and allow it to cool before fueling.
- Do not smoke when fueling.
- Fill the tank at a moderate rate and do not overfill.
- Wipe up spilled fuel and allow the fumes to clear before starting the engine.
- Keep sparks and flame away from the fuel tank.
- Remove the fuel cap slowly to release pressure.

OIL

The RANGER 305D is shipped with the engine crankcase filled with high quality SAE 10W-30 Oil that meets classification CG-4 or CF-4 for diesel engines. **CHECK THE OIL LEVEL BEFORE YOU START THE ENGINE.** If it is not up to the full mark on the dip stick, add oil as required. Check the oil level every four hours of running time during the first 50 running hours. Refer to the engine Operator's Manual for specific oil recommendations and break-in information. The oil change interval is dependent on the quality of the oil and the operating environment. Refer to the Engine Operator's Manual for more details on the proper service and maintenance intervals.



FUEL

USE DIESEL FUEL ONLY

Fill the fuel tank with clean, fresh fuel. The capacity of the fuel tank is 12 gallons (45.4 liters). When the fuel gauge reads empty the tank contains approximately 2 gallons (7.6 liters) of reserve fuel.

NOTE: Close the fuel shutoff valve located on the pre-filter if not running the welder for extended periods.

ENGINE COOLING SYSTEM

⚠ WARNING

HOT COOLANT can burn skin.

- Do not remove cap if radiator is hot.
- The engine and radiator on this machine are filled with a 50% mixture of ethylene-glycol based permanent type antifreeze. See the *Maintenance* section and the engine Operation's Manual for more information.

BATTERY CONNECTION

⚠ WARNING

BATTERY ACID CAN BURN EYES AND SKIN.



• Wear gloves and eye protection and be careful when working near a battery. Follow the instructions printed on the battery.

• Use caution as the electrolyte is strong acid that can burn skin and damage eyes.

The RANGER 305D is shipped with the negative battery cable disconnected. Make certain that the RUN-STOP switch is in the STOP position. Access the negative post of the battery by opening the left side engine cover. Attach the negative battery cable to the negative battery terminal and tighten using a socket or wrench.

NOTE: This machine is furnished with a wet charged battery; if unused for several months, the battery may require a booster charge. Be careful to charge the battery with the correct polarity. See battery charging instructions in the *Maintenance* section.

MUFFLER OUTLET PIPE

Using the clamp provided secure the outlet pipe to the outlet tube with the pipe positioned to direct the exhaust in the desired direction. Tighten using a socket or wrench.

SPARK ARRESTER

Some federal, state or local laws may require that gasoline or diesel engines be equipped with exhaust spark arresters when they are operated in certain locations where unarrested sparks may present a fire hazard. The standard muffler included with this welder does not qualify as a spark arrester. When required by local regulations, a suitable spark arrester must be installed and properly maintained. See the *Accessories* section for more information.

⚠ CAUTION

An incorrect spark arrester may lead to damage to the engine or adversely affect performance.

HIGH FREQUENCY GENERATORS FOR TIG APPLICATIONS.

The K930-2 TIG Module is suitable for use with the Ranger 305D. The Ranger 305D and any high frequency generating equipment must be properly grounded. See the K930-2 operating manual for complete instructions on installation, operation, and maintenance.

RANGER 305D



INSTALLATION

REMOTE CONTROL

The RANGER 305D is equipped with both a 6-pin and a 14-pin Amphenol connector. The 6-pin connector is primarily used to connect a remote control device, such as a K857, or a TIG Amptrol, such as the K870 or K812. The 14-pin Amphenol connector is primarily used to directly connect a wire feeder, TIG module, or Spool Gun module control cable. See **Accessories** section for more information.

NOTE: Both the 6-pin and 14-pin Amphenols share the same output control auto-sensing and contactor circuitry; for this reason, there can only be one device plugged into the Ranger 305D at any time.

Switch operation is covered in "Operation" section.

ELECTRICAL OUTPUT CONNECTIONS

See Figure A.1 for the location of the 120 and 240 volt receptacles, weld output terminals, and ground stud. Output stud covers are provided on code 11275 and above.

MACHINE GROUNDING

Because this portable engine driven welder creates its own power, it is not necessary to connect its frame to an earth ground, unless the machine is connected to premises wiring (home, shop, etc.)

To prevent dangerous electric shock, other equipment to which this engine driven welder supplies power must:

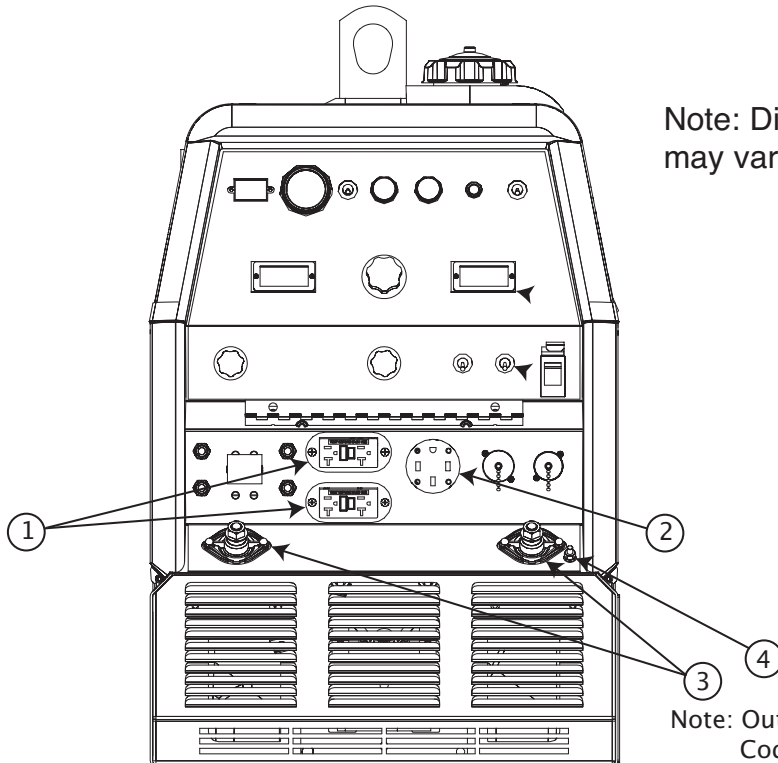
- Be grounded to the frame of the welder using a grounded type plug or be double insulated.

WARNING

Do not ground this machine to a pipe that carries explosive or combustible material.

When this welder is mounted on a truck or trailer, its frame must be electrically bonded to the metal frame of the vehicle. Use a #8 or larger copper wire connected between the machine grounding stud and the frame of the vehicle. When this engine driven welder is connected to premises wiring such as that in a home or shop, its frame must be connected to the system earth ground. See further connection instructions in the section entitled "Standby Power Connections" as well as the article on grounding in the latest National Electrical Code and the local code.

Figure A.1 - RANGER 305D OUTPUT CONNECTIONS



Note: Different models appearance may vary slightly.

Note: Output stud covers not shown. Code 11275 and above

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In general, if the machine is to be grounded, it should be connected with a #8 or larger copper wire to a solid earth ground such as a metal water pipe going into the ground for at least ten feet and having no insulated joints, or to the metal framework of a building which has been effectively grounded. The National Electrical Code lists a number of alternate means of grounding electrical equipment. A machine grounding stud marked with the \oplus ground symbol is provided on the front of the welder.

WELDING OUTPUT CABLES

With the engine off connect the electrode and work cables to the output terminals. The welding process dictates the polarity of the electrode cable. These connections should be checked periodically and tightened with a wrench.

Table A.1 lists recommended cable sizes and lengths for rated current and duty cycle. Length refers to the distance from the welder to the work and back to the welder. Cable diameters are increased for long cable lengths to reduce voltage drops. Long lengths of cable should not be left coiled when welding.

CABLE INSTALLATION TABLE A.1

TOTAL COMBINED LENGTH OF ELECTRODE AND WORK CABLES	
Cable Length	Cable Size for 305 Amps 100% Duty Cycle
0-100Ft. (0-30 meters)	1 / 0 AWG
100-150 Ft. (30-46 meters)	2 / 0 AWG
150-200 Ft. (46-61 meters)	3 / 0 AWG

Install the welding cables to your RANGER 305D as follows.

1. The engine must be OFF to install welding cables.
2. Remove the flanged nuts from the output terminals.
3. Connect the electrode and work cables to the weld output terminals. The terminals are identified on the case front.
4. Tighten the flanged nuts securely.
5. Be certain that the metal piece you are welding (the "work") is properly connected to the work clamp and cable.
6. Check and tighten the connections periodically.

NOTE: Long lengths of welding cable should not remain coiled or wrapped while welding.

⚠ CAUTION

- Loose connections will cause the output terminals to overheat. The terminals may eventually melt.
- Do not cross the welding cables at the output terminal connection. Keep the cables isolated and separate from one another.

AUXILIARY POWER RECEPTACLES

The auxiliary power of the RANGER 305D consists of two 20 Amp-120 VAC (5-20R) duplex receptacles with GFCI protection and one 50 Amp 120/240 VAC (14-50R) receptacle. The 240 VAC receptacle can be split for single phase 120 VAC operation.

The auxiliary power capacity is 10,000 watts Peak, 9,500 Watts Continuous of 60 Hz, single phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The max permissible current of the 240 VAC output is 42 amps. The 240 VAC output can be split to provide two separate 120 VAC outputs with a max permissible current of 42 Amps per output to two separate 120 VAC branch circuits (these circuits cannot be paralleled). Output voltage is within $\pm 10\%$ at all loads up to rated capacity. Auxiliary power is protected by circuit breakers.

The 120 V auxiliary power receptacles should only be used with three wire grounded type plugs or approved double insulated tools with two wire plugs. The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle.

NOTE: The 240 V receptacle has two 120 V circuits, but are of opposite polarities and cannot be paralleled.

STANDBY POWER CONNECTIONS

The RANGER 305D is suitable for temporary, standby or emergency power using the engine manufacturer's recommended maintenance schedule.

The RANGER 305D can be permanently installed as a standby power unit for 240 VAC, 3 wire, single phase, 50 amp service. Connections must be made by a licensed electrician who can determine how the 120/240 VAC power can be adapted to the particular installation and comply with all applicable electrical codes. The following information can be used as a guide by the electrician for most applications. Refer to the connection diagram in **Figure A.2**.

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1. Install the double-pole, double-throw switch between the power company meter and the premises disconnect. Switch rating must be the same or greater than the customer's premises disconnect and service over-current protection.
2. Take necessary steps to assure load is limited to the capacity of the Ranger 305D by installing a 50 amp, 240 VAC double-pole circuit breaker.
3. Install a 50 amp, 120/240 VAC plug (NEMA Type 14-50 to the double-pole circuit breaker using No. 6, 4-conductor cable of the desired length. (The 50 amp, 120/240 VAC plug is available in the optional K802R plug kit or as part number T12153-9.
4. Plug this cable into the 50 amp, 120/240 VAC receptacle on the Ranger 305D case front.

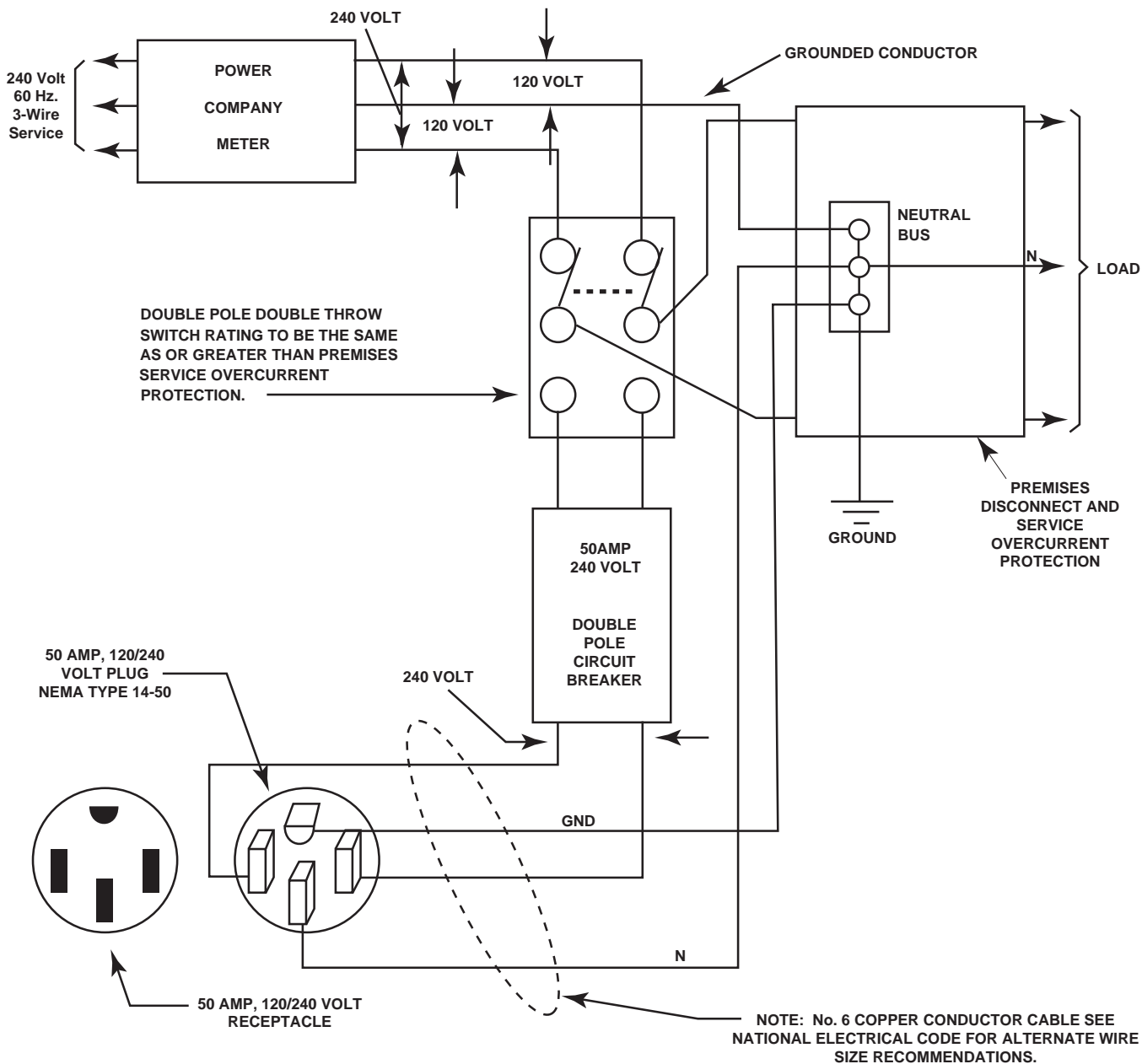
Maximum continuous rated load for each leg of the 240 VAC auxiliary is 40 amperes. Loading above the rated output will reduce output voltage below the allowable +/- 10% of rated voltage, which may damage appliances or other motor-driven equipment and may result in overheating of the Ranger 305D engine and/or alternator windings.

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FIGURE A.2 CONNECTION OF RANGER 305D TO PREMISES WIRING



⚠ WARNING

- Only a licensed, certified, trained electrician should install the machine to a premises or residential electrical system. Be certain that:
- The installation complies with the National Electrical Code and all other applicable electrical codes.
- The premises is isolated and no feedback into the utility system can occur. Certain state and local laws require the premises to be isolated before the generator is linked to the premises. Check your state and local requirements.
- A double pole, double throw transfer switch in conjunction with the properly rated double-pole/ double throw circuit breaker is connected between the generator power and the utility meter.

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OPERATION

OPERATING INSTRUCTIONS

Read and understand this entire section before operating your Ranger 305D.

SAFETY INSTRUCTIONS

WARNING

Do not attempt to use this equipment until you have thoroughly read all the operating and maintenance manuals supplied with your machine. They include important safety precautions; detailed engine starting, operating and maintenance instructions and parts lists.

ELECTRIC SHOCK can kill.



- Do not touch electrically live parts such as output terminals or internal wiring.
- Insulate yourself from work and ground.
- Always wear dry insulating gloves.

FUMES AND GASES can be dangerous.



- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.

WELDING SPARKS can cause fire or explosion.



- Keep flammable material away.
- Do not weld on containers that have held combustibles.

ARC RAYS can burn.



- Wear eye, ear, and body protection.

WARNING

ENGINE EXHAUST can kill.



- Use in open, well ventilated areas or vent exhaust to the outside.
- Do not stack anything on or near the engine.

MOVING PARTS can injure.



- Do not operate this equipment with any of its doors open or guards off.
- Stop the engine before servicing it.
- Keep away from moving parts.

Only qualified personnel should install, use, or service this equipment.

ADDITIONAL SAFETY PRECAUTIONS

Always operate the welder with the hinged door closed and the side panels in place. These provide maximum protection from moving parts and insure proper cooling air flow.

GENERAL DESCRIPTION

The Ranger 305D is a diesel-engine-powered DC multi-process welding power source and 120 / 240 VAC power generator. The engine drives a generator that supplies three-phase power for the DC welding circuit and single-phase power for the AC auxiliary outlets. The DC welding control system uses state of the art **Chopper Technology** (CT™) for superior welding performance.

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OPERATION

DESIGN FEATURES

- Single, full-range output control dial.
- 4 welding modes: CC-stick, downhill stick welding on pipe, CV wire welding and Touch-Start TIG™ (eliminates high frequency and tungsten contamination).
- Output at welding terminals controlled by electronic contactor. Can be switched to “On”, or to “Remotely Controlled”.
- Many wire feeder combinations: 14-pin connector for Lincoln wire feeders LN-25, LN-23P, LN-7, LN-8 operates when using a Lincoln wire feeder with the appropriate control cable.
- Smart machine! Remote operation and Magnum® spool gun; 42VAC for LN-742 and Cobramatic® wire feeders.
- 12 gallon fuel capacity allows you to run an extended day.
- Easily check fuel level during operation and refuelling with highly visible fuel gauge.

Some models have gauge located next to fuel cap on case top.

Some models have gauge located on front panel.
- Voltmeter and ammeter display actual volts and amps at output terminals when welding.
- Longer engine life, reduced noise emissions and great fuel economy with the automatic engine idler.
- Conveniently located engine maintenance label under top engine door.
- Engine hour meter for scheduled maintenance.
- Electric start.
- Oil drain valve (no tools required).
- See spec pages for watts of continuous duty AC generator power.
- See spec pages for Amp and voltages output specs. Circuit breaker protection.
- See spec pages for receptacle information.

CONTROL AND SETTINGS

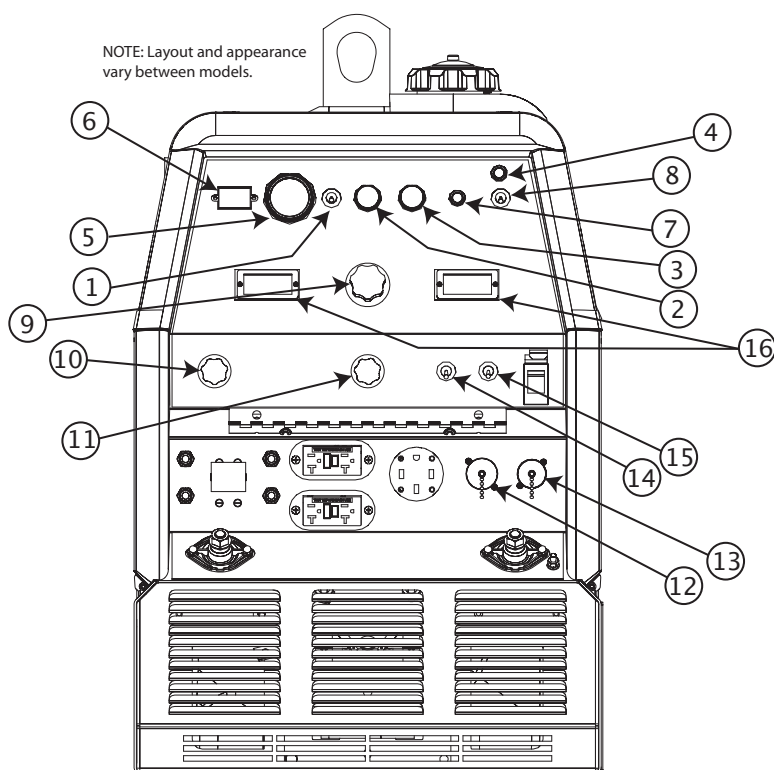
The diesel engine stop/start and idler controls are located on the case front panel. The welder controls are also located here. See **Figure B.1**.

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OPERATION

FIGURE B.1



ENGINE CONTROLS (Figure B.1)

1. RUN/STOP SWITCH: RUN position energizes the engine prior to starting. STOP position stops the engine.

2. GLOW PLUG PUSH BUTTON: When pressed, this button activates the engine glow plugs to preheat the engine for starting. This button also temporarily powers the fuel solenoid hold coil. On codes 10926 and 11121, the electric fuel pump is also temporarily activated.

3. START PUSH BUTTON: Energizes the starter to crank the engine and activates the fuel solenoid pull coil.

A) In the HIGH position, the engine runs at the high idle speed controlled by the engine governor.

B) In the AUTO position, the idler operates as follows:

a. When switched from HIGH to AUTO or after starting the engine, the engine will operate at high speed for approximately 12 seconds and then go to low idle speed.

b. When the electrode touches the work or power is drawn from the auxiliary power receptacles (approximately 100 watts minimum, the engine accelerates and operates at high speed.

c. When welding ceases or the AC power load is turned off, a fixed time delay of approximately 12 seconds starts. If the welding or AC power load is not restarted before the end of the time delay, the idler reduces the engine RPM to low idle speed.

d. The engine will automatically return to high idle speed when the welding load or AC power load is reapplied.

4. ENGINE ALTERNATOR TROUBLE LIGHT:

The yellow engine alternator light is off when the battery charging system is functioning normally. If the light turns on, the alternator or the voltage regulator may not be operating correctly. The light may also come on if the battery is not holding a charge. It is normal for the light to come on while starting the engine. (Code 10926 and over)

5. ELECTRIC FUEL GAUGE: (Codes 11121 and higher) gives accurate and reliable indication as to how much fuel is in the fuel tank.

6. ENGINE HOUR METER: Displays the total time that the engine has been running. This meter is useful for scheduling prescribed maintenance.

7. ENGINE PROTECTION LIGHT: A warning indicator light for low oil pressure and/or coolant over temperature. The light is off when the systems are functioning properly. The light turns on then the RUN/STOP switch is in the "ON" position before starting the engine. If the Engine Protection or Battery Charging lights do NOT turn off shortly after starting the engine, stop the engine immediately and determine the cause.

8. IDLER SWITCH: Has two positions as follows:

1) In the HIGH position, the engine runs at the high idle speed controlled by the engine governor.

2) In the AUTO position, the idler operates as follows:

- When switched from HIGH to AUTO or after starting the engine, the engine will operate at full speed for approximately 12 seconds and then go to low idle speed.

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- When the electrode touches the work or power is drawn for lights or tools (approximately 100 Watts minimum), the engine accelerates and operates at full speed.
- When welding ceases or the AC power load is turned off, a fixed time delay of approximately 12 seconds starts. If the welding or AC power load is not restarted before the end of the time delay, the idler reduces the engine speed to low idle speed.
- The engine will automatically return to high idle speed when there is welding load or AC power load reapplied.

WELDING CONTROLS

9. OUTPUT CONTROL: The output control dial is used to present the output voltage or current as displayed on the digital meters for each of the four welding modes. It can also be used to vary the output while welding. This control is disabled by an auto-sensing circuit if the machine is in CC-Stick, Downhill pipe, or CV-wire modes, and an accessory device with output control capability is plugged into either amphenol.

When in Touch-Start TIG mode, and when an accessory device with output control, such as an Amptrrol, is plugged in to either Amphenol, the OUTPUT control dial is used to set the maximum current range of the accessory output control device.

10. WELD MODE SELECTOR SWITCH: This switch provides four selectable welding modes:

- CV-WIRE
- DOWNHILL PIPE
- CC-STICK
- TOUCH STARTING

11. ARC CONTROL- The ARC CONTROL dial is active in the CV-WIRE, CC-STICK, and DOWNHILL PIPE modes, and has different functions in these modes. This control is not active in the TOUCH START TIG mode.

CC-STICK mode: In this mode, the ARC CONTROL dial sets the short circuit current (arc-force) during stick welding to adjust for a soft or crisp arc. Increasing the dial from -10 (soft) to +10 (crisp) increases the short circuit current and prevents sticking of the electrode to the plate while welding. This can also increase spatter. It is recommended that the ARC CONTROL be set to the minimum number without electrode sticking. Start with a setting at 0.

DOWNHILL PIPE mode: In this mode, the ARC CONTROL dial sets the short circuit current (arc-force) during stick welding to adjust for a soft or a more forceful digging arc (crisp). Increasing the number from -10 (soft) to +10 (crisp) increases the short circuit current which results in a more forceful digging arc. Typically a forceful digging arc is preferred for root and hot passes. A softer arc is preferred for fill and cap passes where weld puddle control and deposition ("stacking" of iron) are key to fast travel speeds. It is recommended that the ARC CONTROL be set initially at 0.

CV-WIRE mode: In this mode, turning the ARC CONTROL clock wise from -10 (soft) to +10 (crisp) changes the arc from soft and washed-in to crisp and narrow. It acts as an inductance/pinch control. The proper setting depends on the procedure and operator preference. Start with a setting of 0.

12. 14-PIN AMPHENOL: Primarily used for attaching accessories, such as a wire feeder, spool gun module or TIG module. It provides connections to both 120VAC and 42VAC power, and to the weld circuit work voltage sensing lead. It also provides a connection to the same control circuits described in the 6-PIN AMPHENOL section below.

13. 6-PIN AMPHENOL- Primarily used to connect a remote control device, such as the K857, or a TIG Amptrrol, such as the K870 or K812.

Both the 6 and 14-Pin amphenols are connected to a remote control auto-sensing circuit that transfers all or partial output control functions from the front panel output control dial to the remote output control device.

When in TOUCH START TIG mode, a remote output control device will vary the output from MIN up to the value set with the front panel output control dial. In all other modes, the front panel output control is completely disabled, and full MIN to MAX control is transferred to the remote output control device.

Both Amphenols also connect to an electronic output contactor circuit. When the "Weld Terminals" switch is in the "remotely controlled" position, the weld terminals are switched on an doff by the device connected to either amphenol.

NOTE: Both the 6 pin and 14 pin Amphenols share the same output control auto-sensing and contactor circuitry; for this reason, there can only be one device plugged into the Ranger 305D at any time.

14. WELD TERMINALS CONTROL SWITCH- In the WELD TERMINALS ON position, the output is electrically hot all the time. In the REMOTELY CONTROLLED position, the output is controlled by a wire feeder or amptrrol device, and is electrically off until a remote switch is closed.

15. WIRE FEEDER VOLTMETER SWITCH: Matches the polarity of the wire feeder voltmeter to the polarity of the electrode.

16. DIGITAL OUTPUT METERS: The digital meters allow the output voltage ("CV-WIRE" mode) or current ("CC-STICK", "DOWNHILL PIPE" and "TOUCH START TIG" modes) to be preset prior to welding using the output control dial. When pre-setting voltage the AMPS display will be off and while pre-setting amps, the VOLTS display will be off. While welding, the machine display both the actual voltage (VOLTS) and current (AMPS).

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OPERATION

ENGINE OPERATION

WARNING

DO NOT RUN THE ENGINE AT EXCESSIVE SPEEDS. The maximum allowable high idle speed for the Ranger 305D is 3650 RPM, no load. Do NOT adjust the governor screw on the engine. Severe personal injury and damage to the machine can result if it is operated at speeds above the maximum rated speed.

Read and understand all safety instructions included in the engine operator's manual that is shipped with your Ranger 305D.

BEFORE STARTING THE ENGINE

Check and fill the engine oil level:

1. Be sure the machine is on a level surface.
2. Open the right side (facing control panel) engine door and remove the engine oil dipstick and wipe it with a clean cloth. Reinsert the dipstick and check the level on the dipstick.
3. Add oil (if necessary) to bring the level up to the full-mark. Do not overfill. Close the engine door.
4. Open the left side engine door and check the coolant level in the coolant recovery tank. Add coolant if necessary. See Maintenance section of this manual for details.
5. See the **Maintenance** section for specific oil and antifreeze recommendations.

Check and fill the engine fuel tank:

WARNING




DIESEL FUEL can cause fire.

- Stop engine while fueling.
 - Do not smoke when fueling.
 - Keep sparks and flame away from tank.
 - Do not leave unattended while fueling.
 - Wipe up spilled fuel and allow fumes to clear before starting engine.
 - Do not overfill tank, fuel expansion may cause over-flow.
- DIESEL FUEL ONLY**

1. Remove the fuel tank cap.
2. Fill the tank approximately 4 inches (100mm) from the top of the filler neck to allow for fuel expansion. (Observe the fuel gauge while filling) DO NOT FILL THE TANK TO THE POINT OF OVERFLOW.
3. Replace the fuel cap and tighten securely.
4. See the **Maintenance** section and engine manual for specific fuel recommendations.

STARTING THE ENGINE

1. Remove all plugs connected to the AC power receptacles.
2. Set IDLER switch to AUTO. 
3. Set the RUN/STOP switch to RUN.
4. Press Glow Plug Button and hold 5 to 10 seconds.
5. Press and hold both the "Glow Plug" Button and START button together until the engine starts or for up to 10 seconds.
6. Release the engine START button immediately when the engine starts.
7. Release the glow plug button after the Engine Protection Light turns off or after an additional 5 seconds maximum.
8. The engine will run at high idle speed for approximately 12 seconds and then drop to low idle speed. Allow the engine to warm up at low idle for several minutes before applying a load and/or switching to high idle. Allow a longer warm up time in cold weather.

NOTE: If the unit fails to start repeat step 4 through step 7 after waiting 30 seconds

CAUTION

- Do not allow the starter motor to run continuously for more than 20 seconds.
- Do not push the START button while the engine is running because this can damage the ring gear and/or the starter motor.
- If the Engine Protection or Battery Charging Lights do "not" turn off shortly after starting the engine shut off the engine immediately and determine the cause.

NOTE: When starting a RANGER 305D for the first time, or after an extended period of time of not operating, it will take longer than normal because the fuel pump has to fill the fuel system.

STOPPING THE ENGINE

1. Remove all welding and auxiliary power loads and allow the engine to run at low idle speed for a few minutes to cool the engine.
2. Stop the engine by placing the RUN-STOP switch in the STOP position.

NOTE: A fuel shut off valve is located on the fuel pre-filter.

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BREAK-IN PERIOD

Any engine will use a small amount of oil during its "break-in" period. For the diesel engine on the Ranger 305D, break-in is about 50 running hours.

Check the oil every four hours during break-in, and change both oil and oil filter at 50 hours of operation. Change the oil every 75 hours thereafter and the oil filter every 150 hours. For more details, see the **Maintenance** section of this manual.

During break-in, subject the Ranger 305D to moderate loads. Avoid long periods running at idle. Before stopping the engine, remove all loads and allow the engine to cool several minutes.

STICK WELDING

The Ranger 305D can be used with a broad range of DC stick electrodes.

The MODE switch provides two stick welding settings as follows:

Constant Current (CC-STICK) Welding

The CC-STICK position of the MODE switch is designed for horizontal and vertical-up welding with all types of electrodes, especially low hydrogen. The OUTPUT control dial adjusts the full output range for stick welding. The ARC CONTROL dial sets the short circuit current (arc-force) during stick welding to adjust for a soft or crisp arc. Increasing the number from -10(soft) to +10(crisp) increases the short circuit current and prevents sticking of the electrode to the plate while welding. This can also increase spatter. It is recommended that the ARC CONTROL be set to the minimum number without electrode sticking. Start with the dial set at 0.

DOWNHILL PIPE Welding

This slope controlled setting is intended for "out-of-position" and "down hill" pipe welding where the operator would like to control the current level by changing the arc length. The output CONTROL dial adjusts the full output range for pipe welding. The ARC CONTROL dial sets the short circuit current (arc-force) during stick welding to adjust for a soft or more forceful digging arc (crisp). Increasing the number from -10(soft) to +10(crisp) increases the short circuit current which results in a more forceful digging arc. Typically a forceful digging arc is preferred for root and hot passes. A softer arc is preferred for fill and cap passes where weld puddle control and deposition ("stacking" of iron) are key to fast travel speeds.

TABLE B.2 - TYPICAL CURRENT RANGES¹ FOR TUNGSTEN ELECTRODES²

Tungsten Electrode Diameter in. (mm)	DCEN (-)	DCEP (+)	Approximate Argon Gas Flow Flow Rate C.F.H. (l /min.)		TIG TORCH Nozzle Size ^{4,5}
	1%, 2% Thoriated Tungsten	1%, 2% Thoriated Tungsten	Aluminum	Stainless Steel	
0.010 (.25)	2-15	³	3-8 (2-4)	3-8 (2-4)	#4, #5, #6
0.020 (.50)	5-20	³	5-10 (3-5)	5-10 (3-5)	
0.040 (1.0)	15-80	³	5-10 (3-5)	5-10 (3-5)	
1/16 (1.6)	70-150	10-20	5-10 (3-5)	9-13 (4-6)	#5, #6
3/32 (2.4)	150-250	15-30	13-17 (6-8)	11-15 (5-7)	#6, #7, #8
1/8 (3.2)	250-400	25-40	15-23 (7-11)	11-15 (5-7)	
5/32 (4.0)	400-500	40-55	21-25 (10-12)	13-17 (6-8)	#8, #10
3/16 (4.8)	500-750	55-80	23-27 (11-13)	18-22 (8-10)	
1/4 (6.4)	750-1000	180-125	28-32 (13-15)	23-27 (11-13)	

¹ When used with argon gas. The current ranges shown must be reduced when using argon/helium or pure helium shielding gases.

² Tungsten electrodes are classified as follows by the American Welding Society (AWS):

Pure	EWP
1% Thoriated	EWTh-1
2% Thoriated	EWTh-2

Though not yet recognized by the AWS, Ceriated Tungsten is now widely accepted as a substitute for 2% Thoriated Tungsten in AC and DC applications.

³ DCEP is not commonly used in these sizes.

⁴ TIG torch nozzle "sizes" are in multiples of 1/16ths of an inch:

# 4 = 1/4 in.	(6 mm)
# 5 = 5/16 in.	(8 mm)
# 6 = 3/8 in.	(10 mm)
# 7 = 7/16 in.	(11 mm)
# 8 = 1/2 in.	(12.5 mm)
#10 = 5/8 in.	(16 mm)

⁵ TIG torch nozzles are typically made from alumina ceramic. Special applications may require lava nozzles, which are less prone to breakage, but cannot withstand high temperatures and high duty cycles.

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OPERATION

TIG WELDING

The TOUCH START TIG setting of the MODE switch is for DC TIG (Tungsten Inert Gas) welding. To initiate a weld, the OUTPUT control is first set to the desired current and the tungsten is touched to the work. During the time the tungsten is touching the work there is very little voltage or current and, in general, no tungsten contamination. Then the tungsten is gently lifted off the work in a rocking motion, which establishes the arc.

The ARC CONTROL is not active in the TIG mode.

The Ranger 305D can be used in a wide variety of DC TIG welding applications. In general the "Touch Start" feature allows contamination-free starting without the use of a Hi-frequency unit. If desired, the K930-2 TIG Module can be used with the Ranger 305D. **See Table B.2 for reference settings.**

Ranger 305D settings when using the K930-2 TIG Module with an Amptrol or Arc Start Switch:

- Set the MODE Switch to the TOUCH START TIG setting.
- Set the "IDLER" Switch to the "AUTO" position.
- Set the "WELD TERMINALS" switch to the "REMOTELY CONTROLLED" position. This will keep the solid state contactor open and provide a "cold" electrode until the Amptrol or Arc Start switch is pressed

When using the TIG Module, the OUTPUT control on the Ranger 305D is used to set the maximum range of the CURRENT.

WIRE WELDING-CV

Connect a wire feeder to the RANGER 305 D according to the instructions in INSTALLATION INSTRUCTIONS Section.

In the CV-WIRE mode, the Ranger 305D can be used with a broad range of flux cored wire (Innershield and Outershield) electrodes and solid wires for MIG welding (gas metal arc welding). Welding can be finely tuned using the ARC CONTROL. Turning the ARC CONTROL clockwise for -10 (soft) to +10 (crisp) changes the arc from soft and washed-in to crisp and narrow. It acts as an inductance control. The proper setting depends on the procedure and operator preference. Start with the dial set at 0.

Some recommended Innershield electrodes are: NR-311, NS-3M, NR-203 Ni 1%, NR-204H. Recommended Outershield electrodes are :OS-70, OS-71M.

Some recommended solid wires for MIG welding are: .035 (0.9mm), and .045 (1.1mm), L-50 and L-56, .035 (0.9 mm) and .045 (1.1mm) Blue Max MIG 308 LS.

For any electrodes, including those above, the procedure should be kept within the rating of the machine.

ARC GOUGING

The RANGER 305D can be used for limited arc gouging. For optimal performance, set the MODE switch to CC-STICK and the ARC CONTROL to +10.

Set the OUTPUT CONTROL knob to adjust output current to the desired level for the gouging electrode being used according to the ratings in the following Table B.3

**TABLE B.3 - CURRENT RANGE
PER ELECTRODE DIAMETER**

Carbon Diameter	Current Range (DC, electrode positive)
1/8"	75-140 Amps
5/32"	90-150 Amps
3/16"	200-250 Amps

AUXILIARY POWER

WARNING

Be sure that any electrical equipment plugged into the generator AC power receptacles can withstand +/- 10% voltage and a +/- 3% frequency variation.

Start the engine and set the IDLER control switch to the desired operating mode. Full power is available regardless of the welding control settings as long as no welding current is being drawn.

The auxiliary power of the Ranger 305D consists of two 20 amp-120 VAC (5-20R) duplex receptacles and one 50 amps 120/240 VAC (14-50R) receptacle. The 240 VAC receptacle can be split for single-phase 120 VAC operation.

The auxiliary power capacity is 10,000 watts peak, 9,500 watts of continuous 60 Hz, single-phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The maximum permissible, 40 amps continuous current of the 240 VAC output is 42 amps maximum.

NOTE: Machines with code numbers of 11121 and higher are equipped with GFCI duplex receptacles. If a GFCI receptacle is "tripped", it will not reset unless it is receiving nearly full voltage from the generator; for this reason, the engine must be running at high RPM before resetting a GFCI.

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The 240 VAC receptacle can be split to provide two separate 120 VAC outputs with a maximum permissible current of 42 amps peak, 40 amps continuous per outlet to two separate 20 amp branch circuits. (These circuits cannot be paralleled.) Output voltage is within +/- 10% at all loads up to rated capacity.

The 120 V auxiliary power receptacles should only be used with three-wire, grounded type plugs or approved double insulated tools with two-wire plugs. The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle. For extension cord lengths, see Table B.5.

NOTE: The 240 VAC receptacle has two circuits, each of which measure 120 VAC to neutral. However, they are of opposite polarities and **cannot be paralleled**.

SIMULTANEOUS WELDING AND AUXILIARY POWER LOADS

The above auxiliary power ratings are with no welding load. Simultaneous welding and power loads are specified in Table B.4. The permissible currents shown assume that current is being drawn from either the 120 VAC or 240 VAC supply (not both at the same time).

RANGER 305D Simultaneous Welding and Power Loads

Welding Output-Amps at NEMA Arc-Volts	Permissible Auxiliary Power-Watts (Unity Power Factor)	Permissible Auxiliary Current in -Amps @	
		120 VAC*	240 VAC
0	9500	40*, (42* Peak)	40, (42 Peak)
100	7100	40*	30
150	5600	40*	23
200	4500	32	16
250	2800	16	8
300	0	0	0

* Each 120 VAC leg of the 120/240 VAC Full KVA receptacle can deliver a maximum 40 amps, up to a total of 80 amps at 9500 Watts, 60 amps at 7100 Watts, or 46 amps at 5600 Watts. These outputs cannot be paralleled, so the greatest single 120 VAC load is 40 amps.

Each 120 VAC Duplex receptacle is limited to 20 amps maximum.

TABLE B.5 - RANGER 305D Extension Cord Length Recommendations
(Use the shortest length extension cord possible sized per the following table.)

Current (Amps)	Voltage (Volts)	Load (Watts)	Maximum Allowable Cord Length in ft. (m) for Conductor Size											
			14 AWG		12 AWG		10 AWG		8 AWG		6 AWG		4 AWG	
15	120	1800	30	(9)	40	(12)	75	(23)	125	(38)	175	(53)	300	(91)
20	120	2400			30	(9)	50	(15)	88	(27)	138	(42)	225	(69)
15	240	3600	60	(18)	75	(23)	150	(46)	225	(69)	350	(107)	600	(183)
20	240	4800			60	(18)	100	(30)	175	(53)	275	(84)	450	(137)
33	240	8000					60	(18)	100	(30)	175	(53)	250	(76)

Conductor size is based on maximum 2.0% voltage drop.

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ACCESSORIES

OPTIONS / ACCESSORIES

FIELD INSTALLED OPTIONS

The following options/accessories are available for your Ranger 305D from your Lincoln distributor.

K957-1 HEAVY DUTY, TWO WHEEL TRAILER FOR SMALL WELDERS - For road, off-road and in-plant and yard towing. (For highway use, consult applicable federal, state and local laws regarding requirements for brakes, lights, fenders, etc.)

K1737-1 FOUR-WHEEL ALL-TERRAIN UNDERCARRIAGE - For moving by hand.

K1770-1 UNDERCARRIAGE (FACTORY) - For moving by hand on a smooth surface. One or two gas cylinders can be mounted on the rear of the undercarriage with the installation of K1745-1 Cylinder Holder(s).

K1739-1 CABLE CARRIER KIT - For use on K1737-1 and K1770-1 Undercarriages.

K1745-1 SINGLE GAS CYLINDER HOLDER - For use on K1770-1 Undercarriage. One or two may be installed on an undercarriage.

K1789-1 ROLL CAGE - Gives added damage protection.

K886-2 CANVAS COVER - Protects machine when not in use.

K1898-1 SPARK ARRESTER - Attaches between muffler or exhaust elbow.

K704 ACCESSORY KIT - Accessory set includes 35 ft. (10.7meters) 2 AWG electrode cable, 30 ft. (9.1 meters) 2 AWG work cable, headshield with No. 12 filter, G300 work clamp and Cooltong 300 electrode holder. Cables are rated at 300 amps, 40% duty cycle.

K857 28 ft (8.5m) or K857-1 100 ft. (30.4m) REMOTE CONTROL - Portable control provides same dial range as the output control on the welder. Has a convenient 6-pin plug for easy connection to the welder.

K1690-1 GFCI RECEPTACLE KIT - Includes one UL approved 120 volt ground fault circuit interrupter duplex type receptacle with cover and installation instructions. Replaces the factory installed 120V duplex receptacle. Each receptacle of the GFCI Duplex is rated at 20 amps. The maximum total current from the GFCI Duplex is limited to 20 amps. Two kits are required.

K802-N POWER PLUG KIT - Provides four 120 volt plugs rated at 20 amps each and one dual voltage, full KVA plug rated at 120/240 volts, 50 amps.

K802-R POWER PLUG KIT - Provides four 120 volt plugs rated at 15 amps each and one dual voltage, full KVA plug rated at 120/240 volts, 50 amps.

T12153-9 50 AMP, 120/240V POWER PLUG - Provides one dual voltage plug for full KVA power.

TIG WELDING ACCESSORIES

K1783-9 TIG TORCH - For TIG welding with shielding gas. Includes 25 feet of cable.

K963-2 - Hand Amptrol.

K870 - Foot Amptrol

NOTE: TIG welding requires a Magnum™ TIG Gun, appropriate Magnum Parts Kit and argon gas.

SEMI-AUTOMATIC FCAW AND MIG WELDING ACCESSORIES

LN-25 WIRE FEEDER K449 - This portable unit provides CC/CV for flux-cored arc welding (FCAW) and metal inert gas welding (MIG). Includes a gas solenoid and an internal contactor that allows across-the-arc operation with no control cable. The LN-25 provides a "cold" electrode until the gun trigger is pressed. For voltage control at the feeder, a K444-1 Remote Voltage Control Kit or K857 Remote Control is required. Refer to connection instructions later in this section.

LN-7 OR LN-8 WIRE FEEDER - Semiautomatic, constant speed wire feeders.

NOTE: Gas-shielding welding requires a Magnum Gun. Gasless welding requires an Innershield Gun.

LN-742 WIRE FEEDER - A semiautomatic wire feeder with "cold" electrode. Refer to connection instructions later in this section.

MAGNUM SPOOL GUN (K487-25) - A lightweight, semiautomatic wire feeder for aluminum welding with argon gas. Has built-in remote wire speed control in the handle. Requires the K488 SG Control Module. Refer to connection instructions later in this section.

SG CONTROL MODULE (K488) - Controls wire speed and gas flow. Provides the required control interface between the Ranger 305D and the K487-25 Magnum Spool Gun. Requires the K691-10 Input Cable.

K444-1 REMOTE VOLTAGE CONTROL - Provides voltage adjustment control at the feeder. Includes 25 feet of cable.

K126-2 INNERSHIELD GUN - For gasless welding. Includes 15 feet of cable.

K470-2 MAGNUM GUN CONNECTOR KIT - For gas-shielding welding.

K466-1 MAGNUM GUN CONNECTOR KIT - For connecting the Magnum 300 MIG Gun to the feeder for gas-shielding welding.

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ACCESSORIES

K18161 FULL KVA ADAPTER KIT

Plugs into the 120/240V NEMA 14-0R receptacle on the casefront (which accepts 4-prongs plugs) and converts it to a NEMA 6-50R receptacle, (which accepts 3-prong plugs.)

CONNECTION OF LINCOLN ELECTRIC WIRE FEEDERS

⚠ WARNING

ELECTRIC SHOCK can kill.



- . Do not operate with panels open.
- . Disconnect NEGATIVE (-) BATTERY LEAD before servicing.
- . Do not touch electrically live parts.

MOVING PARTS can injure.



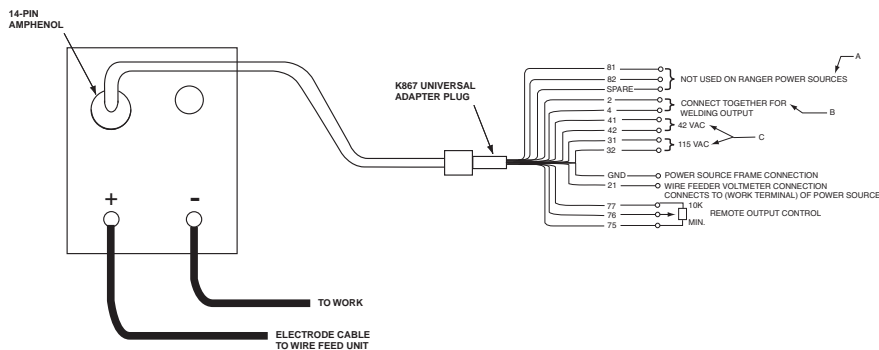
- . Keep guards in place.
- . Keep away from moving parts.
- . Only qualified personnel should install, use or service this equipment.

CONNECTION OF THE RANGER 305D TO WIRE FEEDERS USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.1)

NOTE: When you use the Ranger 305D with non-Lincoln Electric wire feeders or with certain earlier models of Lincoln wire feeders, you will require the K867 Universal Adapter. The following discussion and connection diagram explain in general how to make the proper connections.

1. Shut the welder off.

FIGURE C.1 - Ranger 305D/K867 UNIVERSAL ADAPTER CONNECTION DIAGRAM



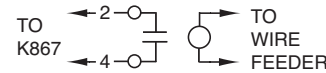
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2. Connect the electrode cable from the wire feeder to the “+” terminal of the welder. Connect the work cable to the “-” terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K867 Universal Adapter to the 14-pin amphenol of the Ranger 305D as shown in Figure C.1. Make the proper connections for local or remote control according to Figure C.1. and the following NOTES, indicated on the figure:



- A. These leads are not used for the Ranger 305D. Insulate each unused lead individually.
 - B. For wire feeders that return a signal for welding output, use an isolation relay to close leads 2 and 4.
 - C. Refer to the **Operation** section of this manual for maximum wire feeder auxiliary current draw.
4. Set the “MODE” switch to the “CV-WIRE” position.
 5. Place the “IDLER” switch in the “AUTO” position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuit may be damaged. The engine governor setting is preset at the factory - do not adjust above RPM specifications listed in this manual.

6. Set the “VOLTMETER” switch to “+” or “-” depending on the polarity chosen.
7. Set the ARC control to “0” initially and adjust to suit.
8. Adjust wire feed speed at the wire feeder.

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CONNECTION OF THE LN-25 TO THE RANGER 305D "ACROSS THE ARC" (SEE FIGURE C.2.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

NOTE: Figure C.2 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 305D output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
4. Set the "MODE" switch to the "CV-WIRE" position.

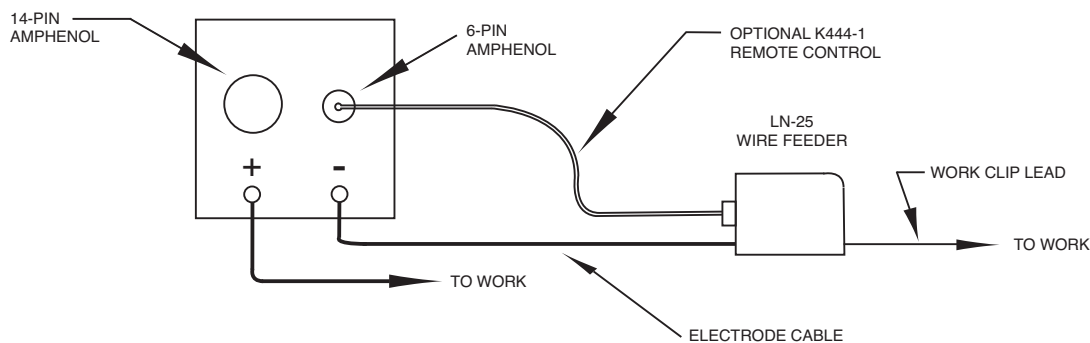
5. Attach the single lead from the LN-25 control box to the work using the spring clip on the end of the lead. This is only a control lead - it carries no welding current.
6. Place the "IDLER" switch in the "AUTO" or "HIGH" position as desired.

CAUTION

If you are using an LN-25 without an internal contactor, the electrode will be "HOT" when the Ranger 305D is started.

7. Place the "WELD TERMINALS" switch in the "WELD TERMINALS ON" position.
8. Adjust wire feed speed at the LN-25 and adjust the welding voltage with the output "CONTROL" at the LN-25 if optional remote control kit is used.
9. Set the ARC control to "0" initially and adjust to suit.

FIGURE C.2 - Ranger 305D/LN-25 ACROSS THE ARC CONNECTION DIAGRAM



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CONNECTION OF THE LN-25 TO THE RANGER 305D WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE (SEE FIGURE C.3.)

1. Shut the welder off.
2. Connect the electrode cable from the K626-XX Input Cable Assembly to the “-” terminal of the welder and to the LN-25 Wire Feeder. Connect the work cable to the “+” terminal of the welder.

NOTE: Figure C.3 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 305D output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the input cable from the K626-XX Input Cable Assembly to the 14-pin amphenol on the Ranger 305D and the input cable plug on the LN-25.
4. Set the “VOLTMETER” switch to “+” or “-” depending on the polarity chosen.

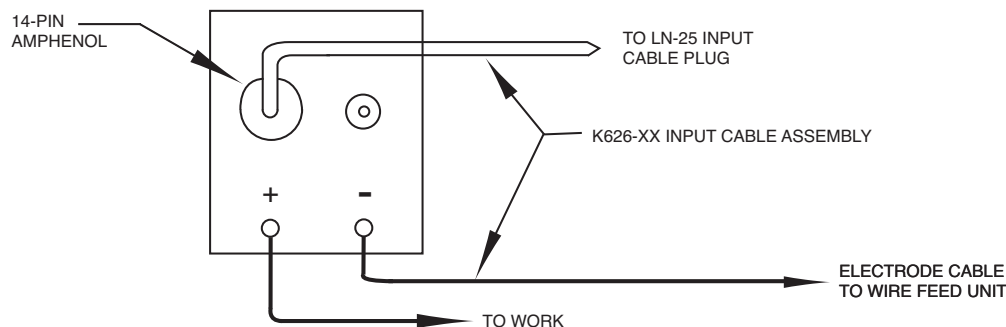
5. Set the “MODE” switch to the “CV-WIRE” position.
6. Place the “IDLER” switch in the “AUTO” or “HIGH” position as desired.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuit may be damaged. The engine governor setting is preset at the factory - do not adjust above RPM specifications listed in this manual.

7. Place the “WELD TERMINALS” switch in the “REMOTELY CONTROLLED” position.
8. Adjust wire feed speed and voltage at the LN-25.
9. Set the ARC control to “0” initially and adjust to suit.

FIGURE C.3 - Ranger 305D/LN-25 WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE CONNECTION DIAGRAM



RANGER 305D



ACCESSORIES

CONNECTION OF THE LN-25 TO THE RANGER 305D "ACROSS THE ARC" WITH K857 REMOTE CONTROL (SEE FIGURE C.4.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

NOTE: Figure C.4 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 305D output terminals.

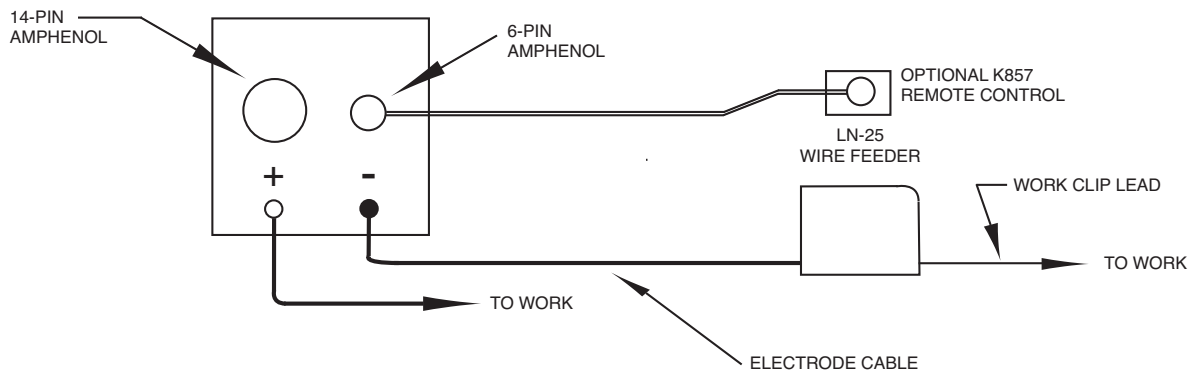
3. Connect the K857 Remote Control to the 6-pin amphenol on the Ranger 305D.
4. Attach the single lead from the LN-25 to the work using the spring clip on the end of the lead. This is only a sense lead - it carries no welding current.
5. Place the "IDLER" switch in the "AUTO" or "HIGH" position, as desired.

⚠ CAUTION

If you are using an LN-25 without an internal contactor, the electrode will be "HOT" when the Ranger 305D is started.

6. Set the "MODE" switch to "CV-WIRE."
7. Set the "WELD TERMINALS" switch in the "WELD TERMINALS ON" position.
8. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
9. Adjust the wire feed speed at the LN-25 and adjust the welding voltage with the K857 if optional remote control is used.
9. Adjust the ARC control to "0" initially and adjust to suit.

FIGURE C.4 - Ranger 305D/LN-25 ACROSS THE ARC CONNECTION DIAGRAM WITH K857 REMOTE CONTROL



RANGER 305D



ACCESSORIES

CONNECTION OF THE LN-7 TO THE RANGER 305D USING K584 CONTROL CABLE (SEE FIGURE C.5.)

NOTE: If your LN-7 comes equipped with a K291 or K404 input cable, refer to CONNECTIONS OF THE LN-7 Using K867 UNIVERSAL ADAPTER, rather than this discussion, to connect your Ranger 305D for wire feed welding.

1. Shut the welder off.
2. Connect the electrode cable from the K584-XX Control Cable to the "+" terminal of the welder and to the LN-7 wire feeder. Connect the work cable to the "-" terminal of the welder.

NOTE: Figure C.5 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the input cable from the K584-XX Control Cable to the 14-pin amphenol on the Ranger 305D and the input cable plug on the LN-7.

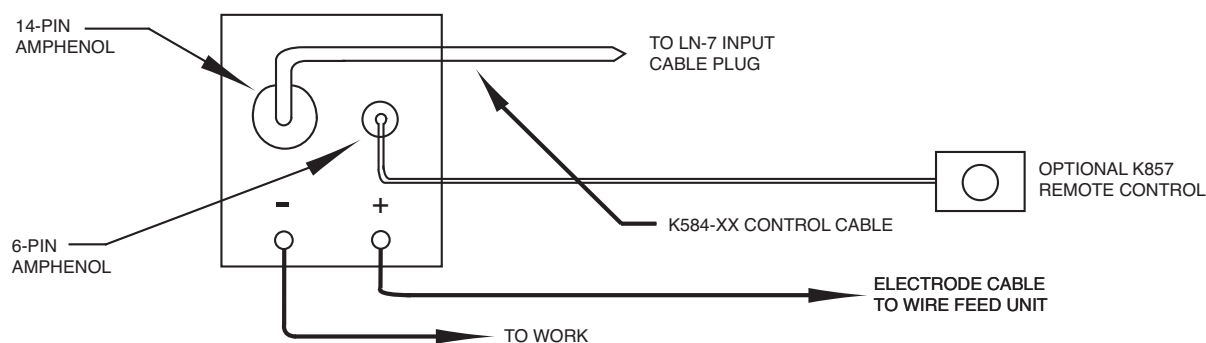
4. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
5. Set the "MODE" switch to the "CV-WIRE" position.
6. Place the "IDLER" switch in the "HIGH" position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuit may be damaged. The engine governor setting is preset at the factory - do not adjust above RPM specifications listed in this manual.

7. Place the "WELD TERMINALS" switch in the "REMOTELY CONTROLLED" position.
8. Adjust the wire feed speed at the LN-7 and adjust the welding voltage with the optional remote control is used.
9. Set the ARC control to "0" initially and adjust to suit.

FIGURE C.5 - Ranger 305D/LN-7 WITH 584 CONTROL CABLE CONNECTION DIAGRAM



RANGER 305D



ACCESSORIES

CONNECTION OF THE LN-8 TO THE RANGER 305D USING K595 CONTROL CABLE (SEE FIGURE C.6.)

NOTE: If your LN-8 comes equipped with a K291 or K404 input cable, refer to CONNECTIONS OF THE LN-7 Using K867 UNIVERSAL ADAPTER, rather than this discussion, to connect your Ranger 305D for wire feed welding.

1. Shut the welder off.
2. Connect the electrode cable from the LN-8 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

NOTE: Figure C.5 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the output terminals.

3. Connect the K595-XX Control Cable to the LN-8.
4. Connect the K595-XX to the 14-pin amphenol on the Ranger 305D.

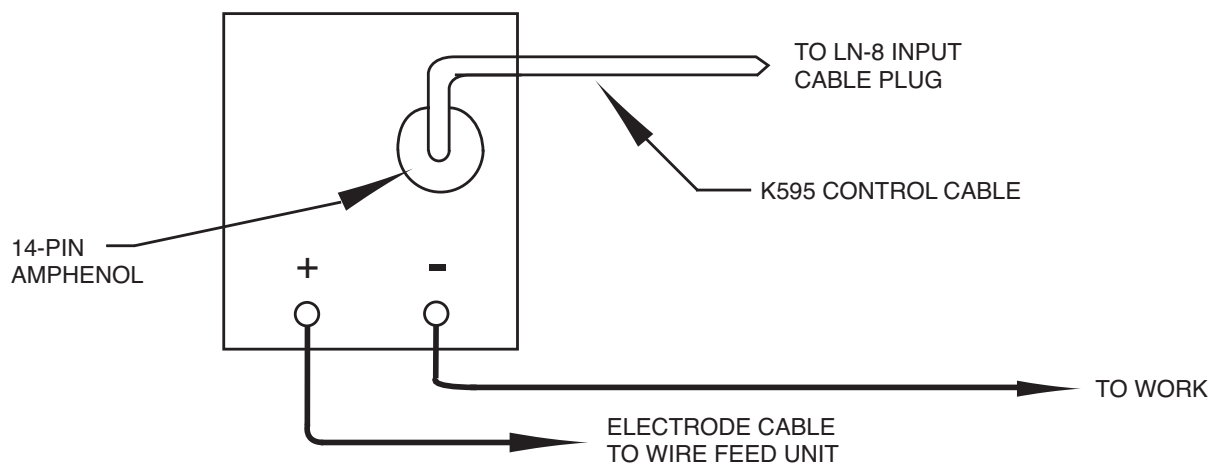
5. Place the "IDLER" switch in the "HIGH" position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuit may be damaged. The engine governor setting is preset at the factory - do not adjust above RPM specifications listed in this manual.

6. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
7. Set the "MODE" switch to "CV-WIRE."
8. Set the "WELD TERMINALS" switch to "WELD TERMINALS REMOTELY CONTROLLED."
9. Adjust wire feed speed and voltage at the LN-8.
10. Adjust the "ARC" control to "0" initially and adjust to suit.

FIGURE C.6 - Ranger 305D/LN-8 WITH K595 CONTROL CABLE CONNECTION DIAGRAM



RANGER 305D



ACCESSORIES

CONNECTION OF THE LN-742 TO THE RANGER 305D. (SEE FIGURE C.7.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-742 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

NOTE: Figure C.7 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

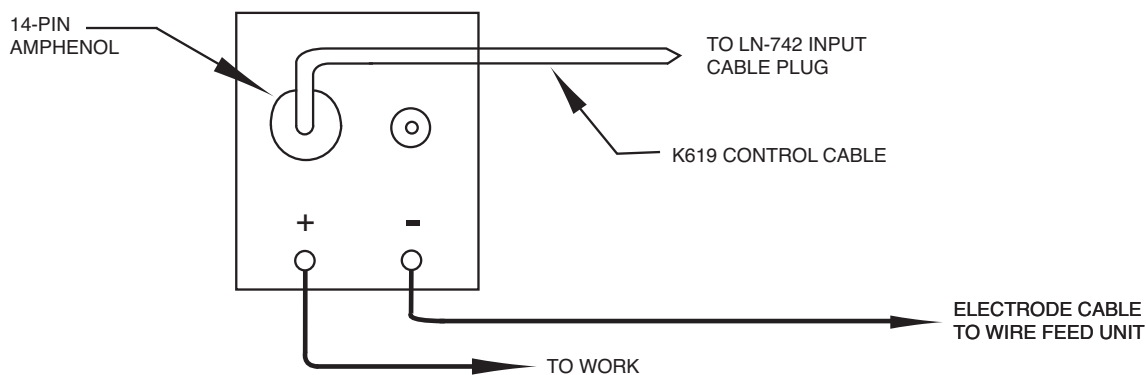
3. Connect the K619 Control Cable to the 14-pin amphenol on the Ranger 305D and the input cable plug on the LN-742..
4. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
5. Set the "MODE" switch to "CV-WIRE" position.
6. Place the "IDLER" switch in the "AUTO" or "HIGH" position, as desired.

⚠ CAUTION

An increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuit may be damaged. The engine governor setting is preset at the factory - do not adjust above RPM specifications listed in this manual.

7. Place the "WELD TERMINALS" switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed and voltage at the LN-742..
9. Set the ARC control to "0" initially and adjust to suit.

FIGURE C.7 - Ranger 305D/LN-742 CONNECTION DIAGRAM



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SAFETY PRECAUTIONS

WARNING

- Have qualified personnel do all maintenance and troubleshooting work.
- Turn the engine off before working inside the machine.
- Remove guards only when necessary to perform maintenance and replace them when the maintenance requiring their removal is complete. If guards are missing from the machine, obtain replacements from a Lincoln Distributor. (See Operating Machine Parts List.)

Read the Safety Precautions in the front of this manual and in the diesel Operator's Manual before working on this machine.

Keep all equipment safety guards, covers, and devices in position and in good repair. Keep hands, hair, clothing, and tools away from the fans and all other moving parts when starting, operating, or repairing the equipment.

ROUTINE AND PERIODIC MAINTENANCE

ENGINE MAINTENANCE

CAUTION

To prevent the engine from accidentally starting, disconnect the negative battery cable before servicing the engine.

See **Table D.2** for a summary of maintenance intervals for the items listed in **Table D.1**. Follow either the hourly or the calendar intervals, whichever come first. More frequent servicing may be required, depending on your specific application and operating conditions. See **Figure D.1** for major component locations.

At the end of each day's use, refill the tank to minimize moisture condensation in the tank. Running out of fuel tends to draw dirt into the fuel system. Also, check the crankcase oil level and add oil if indicated.

TABLE D.1 - ENGINE MAINTENANCE COMPONENTS, KUBOTA D722 DIESEL ENGINE

ITEM	MAKE AND PART NUMBER
OIL FILTER	KUBOTA 70000-15241
AIR FILTER	DONALDOSON P822686
MAIN FUEL FILTER	KUBOTA 15393-43017
FUEL FILTER (IN-LINE)	KUBOTA 12581-43012
BATTERY GROUP 58, 550, CCA	LINCOLN M9399-14
BELT	KUBOTA 15881-97011
GLOW PLUGS	KUBOTA 16851-65512

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MAINTENANCE

TABLE D.2 - KUBOTA D722 ENGINE MAINTENANCE SCHEDULE

INTERVAL	REQUIRED MAINTENANCE
Daily	Fill fuel tank Check oil level Check coolant level Check air cleaner for dirt or damage Check air intake for cracks/looseness (200 hrs per Kubota) Check fan belt tension (Kubota Manual every 100 hrs)
First 50 Hours	Check engine oil and oil filter
75 Hours	Check engine oil
100 Hours	Clean air cleaner element (1) Clean fuel filter Check battery electrolyte level
150 Hours	Change oil filter
200 Hours	Check radiator hoses and clamps
400 Hours	Replace fuel filter
500 Hours	Replace fan belt Flush radiator Remove sediment from fuel tank
800 Hours	Check and adjust valve clearances (2)
1500 Hours	Check fuel injector nozzle pressure (2)
3000 Hours	Check fuel injection pump and timer (2)
Every Year	Replace air cleaner element (1)
Every Two Years	Replace battery Replace radiator hoses and clamps Replace fuel hoses and clamps

KUBOTA D722 DIESEL ENGINE

Note (1) - Service more frequently when used in dusty and/or high ambient temperatures.

Note (2) - Consult your Kubota engine dealer for this service.

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MAINTENANCE

Engine Oil Change



Drain the engine oil while the engine is warm to assure rapid and complete draining. It is recommended that each time the oil is changed the oil filter be changed as well. **See Table D.2.**

- Be sure the unit is off. Disconnect the negative battery cable to ensure safety.
- Locate oil drain hose and valve in bottom of base and pull through the hole in the battery access panel on the welder.
- Remove the cap from the drain valve. Push valve in and twist counterclockwise. Pull to open and drain the oil into a suitable container for disposal.
- Close the drain valve by pushing in and twisting clockwise. Replace the cap.
- Re-fill the crankcase to the upper limit mark on the dipstick with the recommended oil (see engine operation manual OR engine service items decal OR below). Replace and tighten the oil filler cap securely.
- Push oil drain hose and valve back into unit, re-connect negative battery cable, and close doors and engine top cover before restarting unit. Wash your hands with soap and water after handling used motor oil. Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take it in a sealed container to your local service station or recycling center for reclamation. DO NOT throw it in the trash; pour it on the ground or down a drain.

Engine Oil Refill capacities

Without oil filter replacement:

- 3.3 U.S. Quart. (2.7 Imp Quart, 3.2 liter)

With oil filter replacement:

- 3.4 U.S. Quart. (3.0 Imp Quart, 3.2 liter)

Use motor oil designed for diesel engines that meets requirements for API service classification Kubota manual CD/CE/CF/CF-4/CG-4 or CH-4.

Oils levels that meet ACEA Performance levels E1, E2, or E3 can also be used. Always check the service label on the oil container to be sure it includes the letters indicated. (Note: An S-grade oil must not be used in a diesel engine or damage may result. It IS permissible to use an oil that meets S and C grade service classifications.)

SAE 10W30 is recommended for general, all temperature use, 5F to 104F (-15C to 40C).

See engine owner's manual for more specific information on oil viscosity recommendations.

Wash your hands with soap and water after handling used oil.

Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take it in a sealed container to your local service station or recycling center for reclamation. Do not throw it in the trash, pour it on the ground or down a drain.

Oil Filter Change

- Drain the oil.
- Remove the oil filter with an oil filter wrench and drain the oil into a suitable container. Discard the used filter. Note: Care should be taken during filter removal to not disrupt or damage in any way the fuel lines.
- Clean the filter mounting base and coat the gasket of the new filter with clean engine oil.
- Screw the new filter on by hand until the gasket contacts the mounting base. Using an oil filter wrench, tighten the filter an additional 1/2 to 7/8 of a turn.
- Refill the crankcase with the specified amount of the recommended engine oil. Reinstall the oil filler cap and tighten securely
- Start the engine and check for oil filter leaks.
- Stop the engine and check the oil level. If necessary, add oil to the upper limit mark on the dipstick.

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Service Instructions & Installation Tips

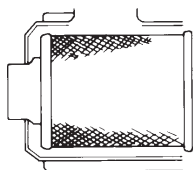
For Engine Air Filter

1 Release the Seal Carefully

Unlatch and remove the service cover of the air cleaner. Make certain the latches are folded back against the cover so that they don't hinder filter removal/installation. Most latches are spring loaded to fold back when open. The filter fits tightly over the outlet tube, creating the critical seal on the inside diameter of the filter endcap. The filter should be removed gently to reduce the amount of dust dislodged. There will be some initial resistance, similar to breaking the seal on a jar. Gently move the end of the filter back and forth to break the seal.



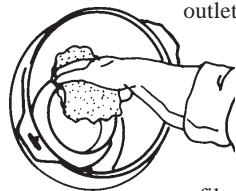
2 Avoid Dislodging Dust from the Filter



Gently pull the filter off the outlet tube and out of the housing. Avoid knocking the filter against the housing.

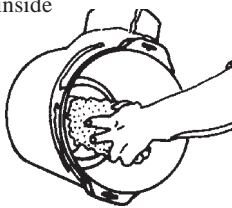
3 Clean Sealing Surface of the Outlet Tube

Use a clean cloth to wipe the sealing surface. Dust on the outside diameter of the outlet tube could hinder an effective seal and cause leakage. Make sure that all contaminant is removed before the new filter is inserted.



4 Clean the Inside of the Outlet Tube

Carefully wipe the inside of the outlet tube with a clean cloth. Dirt accidentally transferred to the inside of the outlet tube will reach the engine and cause wear. (Engine manufacturers says that it takes only a few grams of dirt to dust an engine!) Be careful not to damage the sealing area on the tube.



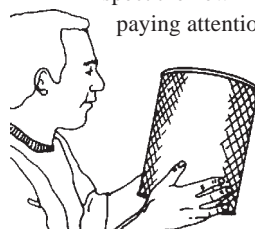
5 Check the Old Filter for Leak Clues

Visually inspect the old filter for any signs of leaks. A streak of dust on the clean side of the filter is a telltale sign. Remove any cause of leaks before installing new filter.



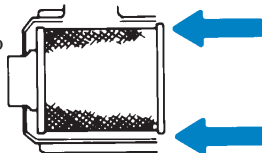
6 Inspect the New Filter for Damage

Inspect the new filter carefully, paying attention to the inside of the open end, which is the sealing area. NEVER install a damaged filter.



7 Insert the New RadialSeal® Filter by Hand

Insert carefully. Seat the new filter by hand, making certain it is completely into the air cleaner housing before latching the cover in place. If the cover hits the filter before it is fully in place, remove the cover and push (by hand) the filter further into the air cleaner and try again. The cover should go on with no extra force.



Never use the latches on the cover to force the filter into the air cleaner! It is tempting to assume the cover will do the job of seating the filter ñ but it will not! Using the latches to push the filter in could cause damage to the housing and will void the warranty.

Donaldson filters with RadialSeal™ Sealing Technology are self-aligning, self-centering, and self-sealing. A new filter has a dry lubricant to aid installation. The critical sealing area will stretch slightly, adjust itself and distribute the sealing pressure evenly. To complete a tight seal, apply pressure by hand at the outer rim of the filter, not the flexible center. (Avoid pushing on the center of the urethane end cap.) No cover pressure is required to hold the seal. Again, do NOT use the service cover to push the filter into place!

When the filter in is place, put the service cover back on, making sure the Vacuator™ Valve points down. Inspect the Vacuator™ Valve for cracks or dust hang-ups to insure that it is functioning properly. Re-fasten the latches.

8 Check Connections for Tight Fit

Make sure that all clamps, bolts, and connections in the entire air intake system are tight. Check for holes in piping, and repair if needed.

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⚠ WARNING

Never use gasoline or low flash point solvents for cleaning the air cleaner element. A fire or explosion could result.

⚠ CAUTION

Never run the engine without the air cleaner. Rapid engine wear will result from contaminants, such as dust and dirt being drawn from the engine.

AIR CLEANER

The diesel engine is equipped with a dry type air filter. Never apply oil to it. Service the air cleaner as follows:

COOLING SYSTEM**⚠ WARNING**

HOT COOLANT can burn skin.

- Do not remove cap if radiator is hot.

Check the coolant level by observing the level in the radiator and recovery bottle. Add 50/50 antifreeze / water solution if the level is close to or below the "LOW" mark. Do not fill above the "FULL" mark. Remove radiator cap and add coolant to radiator. Fill up to the top of the tube in the radiator filler neck which includes a connecting hose coming from the thermostat housing.

To drain the coolant, open the petcock at the bottom of the radiator. Open the radiator cap to allow complete drainage. (Tighten the petcock and refill with a 50/50 antifreeze/water solution.) Use an automotive grade (low silicate) ethylene glycol antifreeze. The cooling system capacity is 3.85 quarts (3.6L.). Squeeze upper and lower radiator hoses while filling to bleed air from system coolant. Replace and tighten the radiator cap.

⚠ CAUTION

Always premix the antifreeze and clean tap water before adding to the radiator. It is very important that a precise 50/50 solution be used with this engine year round. This gives proper cooling during hot weather and freezing protection to -34° F (-37° C).

Cooling solution exceeding 50% antifreeze can result in engine overheating and damage to the engine. Coolant solution must be premixed before adding to radiator.

Periodically remove the dirt from the radiator fins. Periodically check the fan belt and radiator hoses. Replace if signs of deterioration are found.

TIGHTENING THE FAN BELT

If the fan belt is loose, the engine can overheat and the battery lose its charge. Check tightness by pressing on the belt midway between the pulleys. It should deflect about 0.28 to 0.35 in. under a load of 22 lbs. (7 to 9 mm/10Kg).

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MAINTENANCE

FUEL SYSTEM SERVICE

At the end of each day, refill the fuel tank to minimize moisture condensation and dirt contamination in the fuel line. Do not overfill; leave room for expansion

Use only fresh, No. 2 grade DIESEL fuel. Do not use kerosene. See the Engine Operator's Manual for instructions on replacing the fuel filter.

BLEEDING THE FUEL SYSTEM

You may need to bleed air from the fuel system if the fuel filter or fuel lines have been detached, the fuel tank has been run empty or after periods of long storage. It is recommended that the fuel shutoff valve be closed during periods of non-use.

(For Code 10926, 11121)

The Kubota D722 engine supplied with this welder is equipped with an automatic bleeding mechanism that functions when the electric fuel pump is actuated. It is generally not necessary to open a vent screw or fuel line fitting to bleed the fuel system.

(For Code 11888, 11275)

The Kubota D722 engine supplied with this welder is equipped with an automatic bleeding mechanism that helps purge the air from the mechanical fuel pump system. It is generally not necessary to open a vent screw or fuel line fitting to bleed the fuel system. Operate the priming lever on the pump to assist starting and after extended periods of non-use or out of fuel conditions.

⚠ WARNING

To avoid personal injury, do not bleed a hot engine. This could cause fuel to spill onto a hot exhaust manifold, creating a danger of fire.

Bleed the fuel system as follows:

1. Fill the fuel tank with fuel.
2. Open the fuel shut off valve (vertical position of handle) on the Fuel Filter.
3. Press and hold the glow plug button for 10 to 20 seconds. **(For Code 10926, 11121)**
- 3a. Crank the engine by pressing the start button for 45 seconds. **(For Code 11188, 11275)**
4. Check to see that fuel is flowing through both fuel filters
5. Follow the normal STARTING procedures.

FUEL FILTER

1. Check the fuel filter and fuel pre-filter for water accumulation or sediment.

2. Replace the fuel filter if it is found with excessive water accumulation or sediment. Empty fuel pre-filter.

OVERSPEED IS HAZARDOUS

The maximum allowable high idle speed for this machine is 3650 RPM, no load. Do NOT tamper with governor components or setting or make any other adjustments to increase the maximum speed. Severe personal injury and damage to the machine can result if operated at speeds above maximum.

ENGINE ADJUSTMENT

Adjustments to the engine are to be made only by a Lincoln Service Center or an authorized Field Service Shop.

BATTERY MAINTENANCE

To access the battery, Disconnect the Negative and then Positive battery cables. Remove the 2 screws from the battery door using a screwdriver or a 3/8" socket. Remove the 2 nuts from the battery bracket using a 7/16" wrench or socket. Slide the battery out and remove from welder

⚠ WARNING

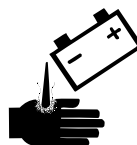


GASES FROM BATTERY can explode.

- Keep sparks, flame and cigarettes away from battery.

To prevent EXPLOSION when:

- **INSTALLING A NEW BATTERY** — Disconnect negative cable from old battery first and connect to new battery last.
- **CONNECTING A BATTERY CHARGER** — Remove battery from welder by disconnecting negative cable first, then positive cable and battery clamp. When reinstalling, connect negative cable last. Keep well ventilated.
- **USING A BOOSTER** — Connect positive lead to battery first, then connect negative lead to the engine foot.



BATTERY ACID can burn eyes and skin.

- Wear gloves and eye protection and be careful when working near battery.
- Follow instructions printed on battery.

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CLEANING THE BATTERY

Keep the battery clean by wiping it with a damp cloth when dirty. If the terminals appear corroded, disconnect the battery cables and wash the terminals with an ammonia solution or a solution of 1/4 pound (0.1113 kg) of baking soda and 1 quart (0.9461) of water. Be sure the battery vent plugs (if equipped) are tight so that none of the solution enters the cells.

After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water. Coat the battery terminals lightly with petroleum jelly or a non-conductive grease to retard corrosion.

Keep the battery clean and dry. Moisture accumulation on the battery can lead to more rapid discharge and early battery failure.

CHECKING THE ELECTROLYTE LEVEL

If battery cells are low, fill them to the neck of the filler hole with distilled water and recharge. If one cell is low, check for leaks.

CHARGING THE BATTERY

When you charge, jump, replace, or otherwise connect battery cables to the battery, be sure the polarity is correct. Improper polarity can damage the charging circuit. The RANGER 305D positive (+) battery terminal has a red terminal cover.

If you need to charge the battery with an external charger, disconnect the negative cable first, then the positive cable before you attach the charger leads. After the battery is charged, reconnect the positive battery cable first and the negative cable last. Failure to do so can result in damage to the internal charger components.

Follow the instructions of the battery charger manufacturer for proper charger settings and charging time.

OPTIONAL SPARK ARRESTOR

⚠ WARNING

MUFFLER MAY BE HOT.

Allow the engine to cool before installing the spark arrestor!

Clean the spark arrestor after every 100 hours of use.

WELDER / GENERATOR MAINTENANCE

STORAGE: Store the RANGER 305D in clean, dry protected areas.

CLEANING: Blow out the generator and controls periodically with low pressure air. Do this at least once a week in particularly dirty areas.

RECEPTACLES: Keep the electrical receptacles in good condition. Remove any dirt, oil, or other debris from their surfaces and holes.

CABLE CONNECTIONS: Check the welding cable connections at the weld output terminals often. Be sure that the connections are always firm.

BRUSH REMOVAL AND REPLACEMENT: It's normal for the brushes and slip rings to wear and darken slightly. Inspect the brushes when a generator overhaul is necessary.

⚠ CAUTION

Do not attempt to polish slip rings while the engine is running.

⚠ WARNING

Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions.

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GFCI RECEPTACLE TESTING AND RESETTING PROCEDURE

The GFCI receptacle should be properly tested at least once every month or whenever it is tripped. To properly test and reset the GFCI receptacle:

- If the receptacle has tripped, first carefully remove any load and check it for damage.
- If the equipment has been shut down, it must be restarted.
- The equipment needs to be operating at high idle speed and any necessary adjustments made on the control panel so that the equipment is providing at least 80 volts to the receptacle input terminals.
- The circuit breaker for this receptacle must not be tripped. Reset if necessary.
- Push the "Reset" button located on the GFCI receptacle. This will assure normal GFCI operation.
- Plug a night-light (with an "ON/OFF" switch) or other product (such as a lamp) into the GFCI receptacle and turn the product "ON".

- Push the "Test" button located on the GFCI receptacle. The night-light or other product should go "OFF".
- Push the "Reset" button, again. The light or other product should go "ON" again.

If the light or other product remains "ON" when the "Test" button is pushed, the GFCI is not working properly or has been incorrectly installed (miswired). If your GFCI is not working properly, contact a qualified, certified electrician who can assess the situation, rewire the GFCI if necessary or replace the device.

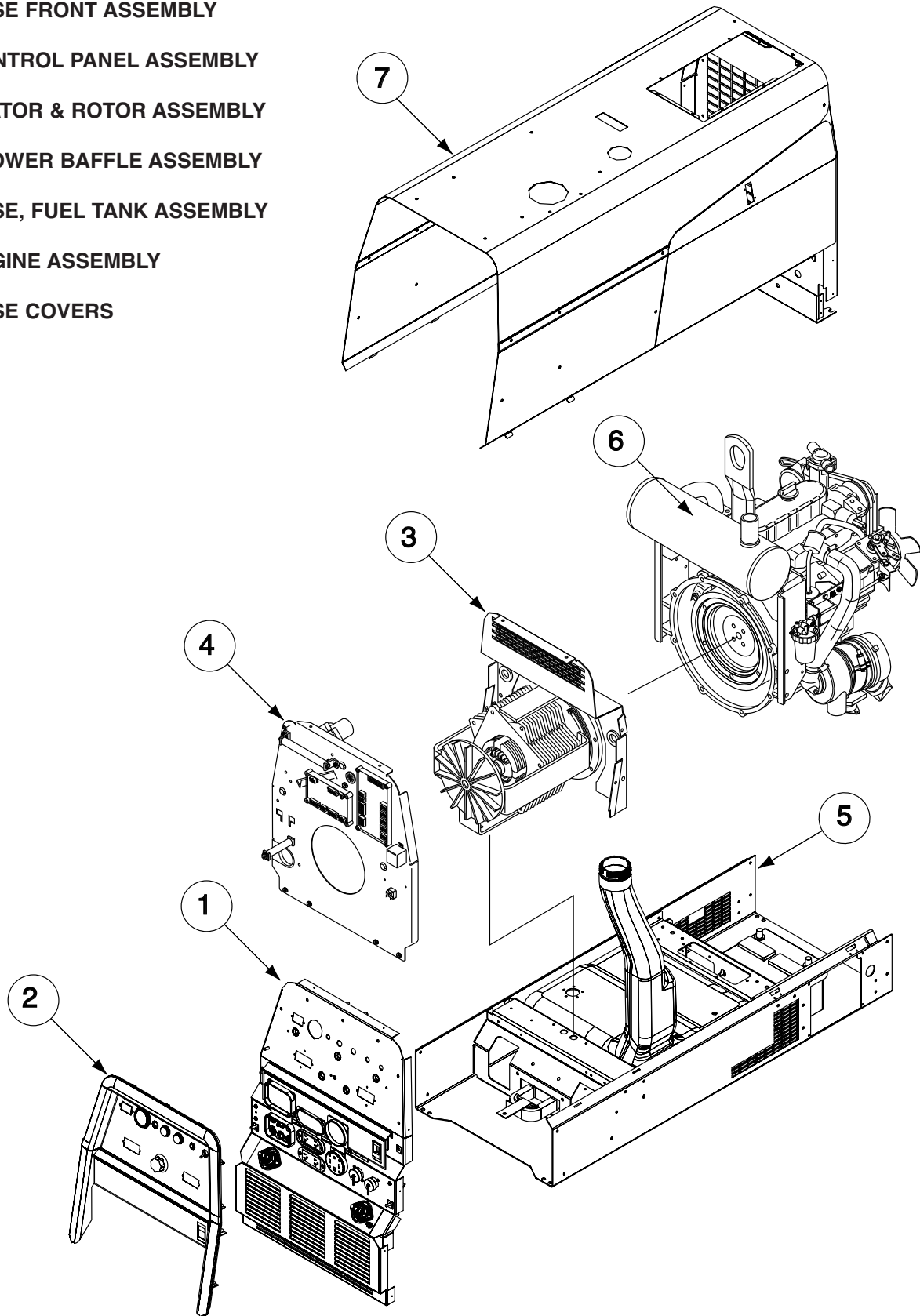
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MAINTENANCE

FIGURE D.1 – MAJOR COMPONENT LOCATIONS

- 1. CASE FRONT ASSEMBLY
- 2. CONTROL PANEL ASSEMBLY
- 3. STATOR & ROTOR ASSEMBLY
- 4. BLOWER BAFFLE ASSEMBLY
- 5. BASE, FUEL TANK ASSEMBLY
- 6. ENGINE ASSEMBLY
- 7. CASE COVERS



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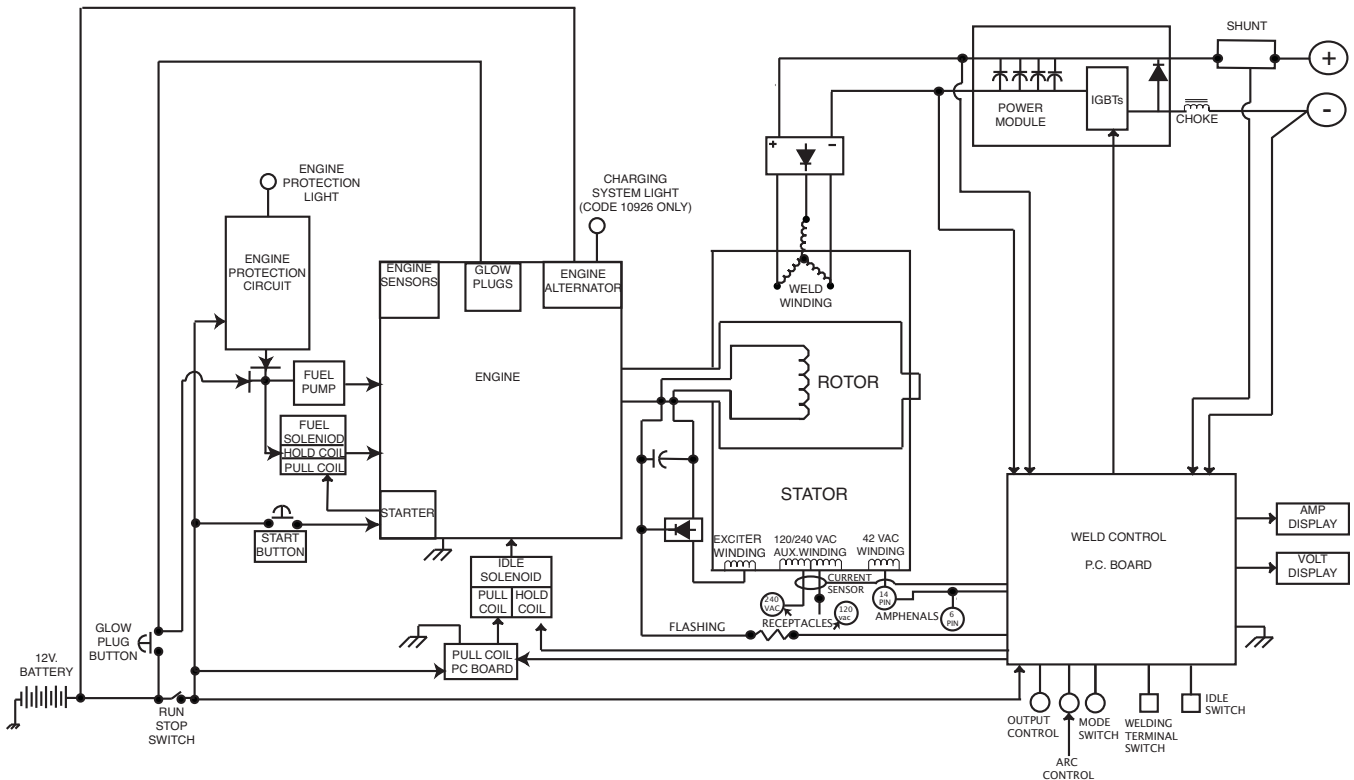
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FIGURE E.1 – RANGER 305D BLOCK LOGIC DIAGRAM



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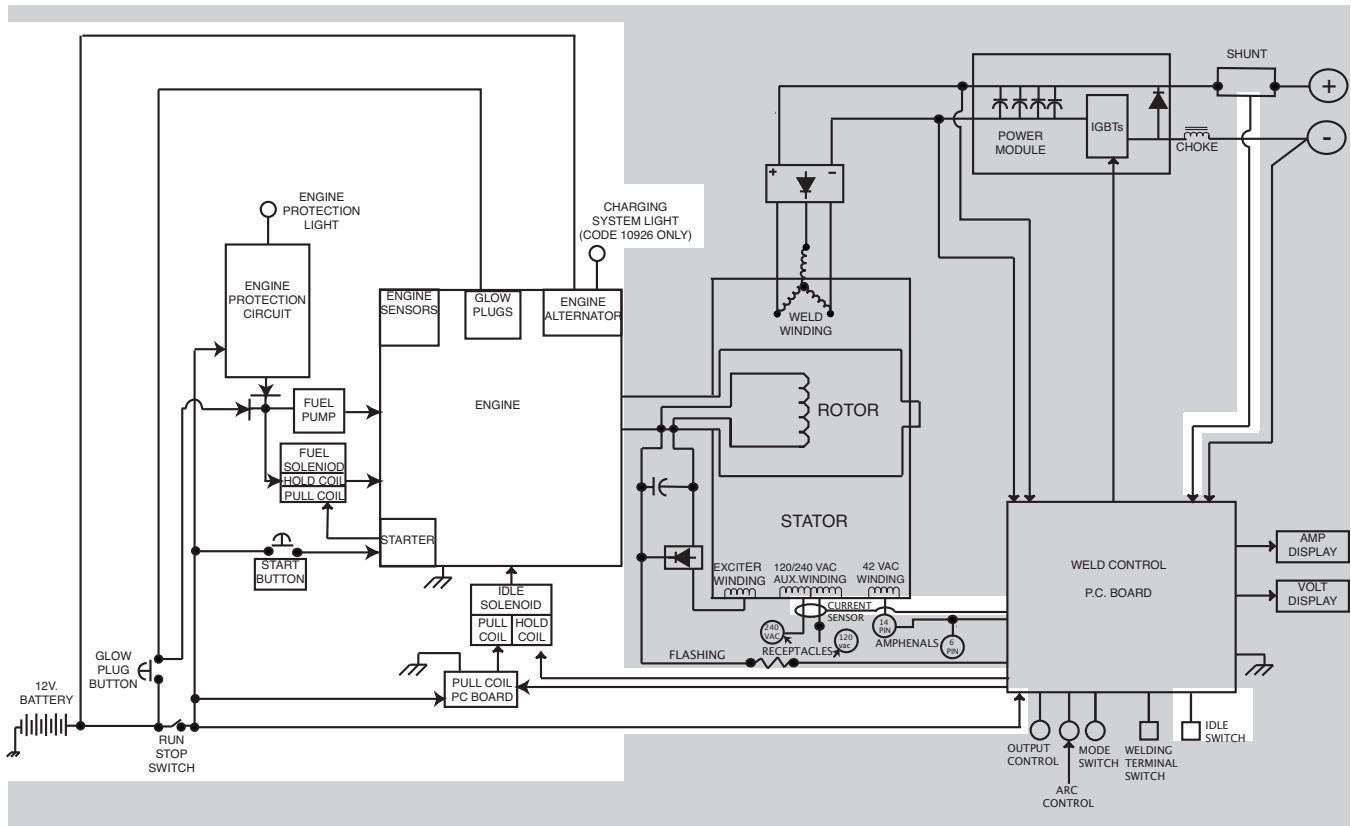
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FIGURE E.2 – BATTERY, ENGINE, ENGINE PROTECTION, CHARGING, IDLE CONTROL



GENERAL DESCRIPTION

The Ranger 305D is a diesel engine-driven welding power source capable of producing 300 amps at 29VDC at a 100% duty cycle. The engine is coupled to a brush-type alternating current generator. This AC output is rectified then controlled by **Chopper Technology** to produce DC current for multi-purpose welding applications. The Ranger 305D is also capable of producing 9,500 watts (10,000 watts peak) of AC auxiliary power at 100% duty cycle.

Battery, Engine, Engine Protection, and Charging System.

BATTERY:

The 12VDC battery powers the engine starter motor, glow plug circuit, engine protection circuit, fuel pump (codes 10926 and 11121), and fuel solenoid. Power is also supplied to other components.

Starting the engine:

Starting the engine first requires that the Run/Stop switch be in the run position. The glow plug button is then pressed and held; this preheats the engine to enhance starting and also temporarily provides power to the fuel pump (codes 10926 and 11121), and fuel solenoid hold coil.

The start button is pressed while still holding the glow plug button. The start button cranks the engine and powers the fuel solenoid pull cord.

The engine starts, builds oil pressure, and spins the engine alternator, which begins charging the battery. The charging system indicator light (code 10926), and the engine protection indicator will turn off. When the engine protection light turns off, the fuel pump (codes 10926 and 11121), and fuel solenoid are receiving power from the engine protection circuit. The operator can now release the glow plug button.

The engine protection system now monitors the oil pressure and coolant temperature sensors. If either sensor detects a fault condition, the engine protection indicator will light, and power will be interrupted to the fuel solenoid, immediately shutting the engine off.

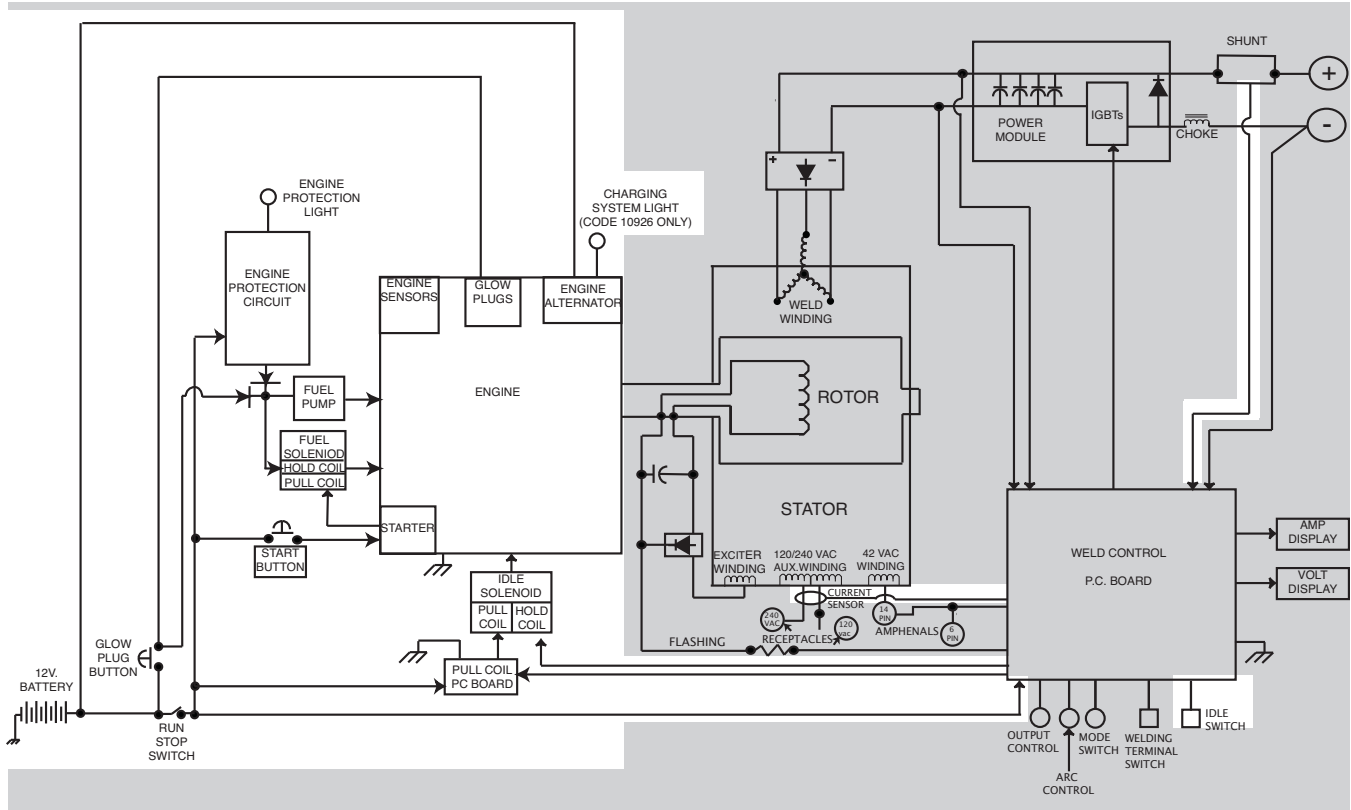
NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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THEORY OF OPERATION


FIGURE E.3 –ENGINE IDLE SYSTEM, IDLE SWITCH & IDLE SOLENOID



Engine Idle System

Idle Switch Operation:

When the engine is started it operates at high RPM. If the idle switch is in the high position  the automatic idle system is inactive and the engine will continue to operate at high RPM.

If the engine is started with the idle switch in the auto position,  or if the idle switch is moved to the auto position while the engine is running, a 12 second on the control PC board is started. If there is no significant current flow detected from the weld or auxiliary outputs during that 12 second time, the idle solenoid will be activated, dropping the engine RPM to preset low idle speed. If a load is applied during the 12 second delay, the engine speed will remain high.

While operating at low RPM; if the idle switch is moved to high, or there is a load detected from either the weld of auxiliary outputs, the idle solenoid will be deactivated, allowing the engine governor to increase the RPM to high speed.

When the idle switch is in the “auto” position and the machine is under load and running at high RPM. If the load is removed, the machine will continue to run at high RPM for 12 seconds, then drop to low RPM, unless a load is re-applied during that 12 second delay

Idle Solenoid Operation:

The engine speed is controlled by a two stage solenoid connected to the engine speed control lever. When the solenoid is inactive, the engine operates at high RPM, and is controlled by the governor. When the solenoid is activated, the speed control lever is pulled to a pre-set low RPM setting.

The solenoid is powered by battery voltage directly from the run/stop switch. The control PC board and pull coil PC board activate the pull and hold coils by providing a path to ground.

When the machine goes to low idle speed, the control PC board grounds the hold coil of the idle solenoid and at the same time it sends a signal of about +14VDC to the pull coil PC board. This DC signal remains at +14VDC for the entire time that the hold coil is active. When the signal is applied to the Pull coil PC board, the board will energize the pull coil of the idle solenoid for a brief moment, normally less than one second. This momentary activation of the pull coil supplies the needed power to reliably move the speed control lever to the low idle position.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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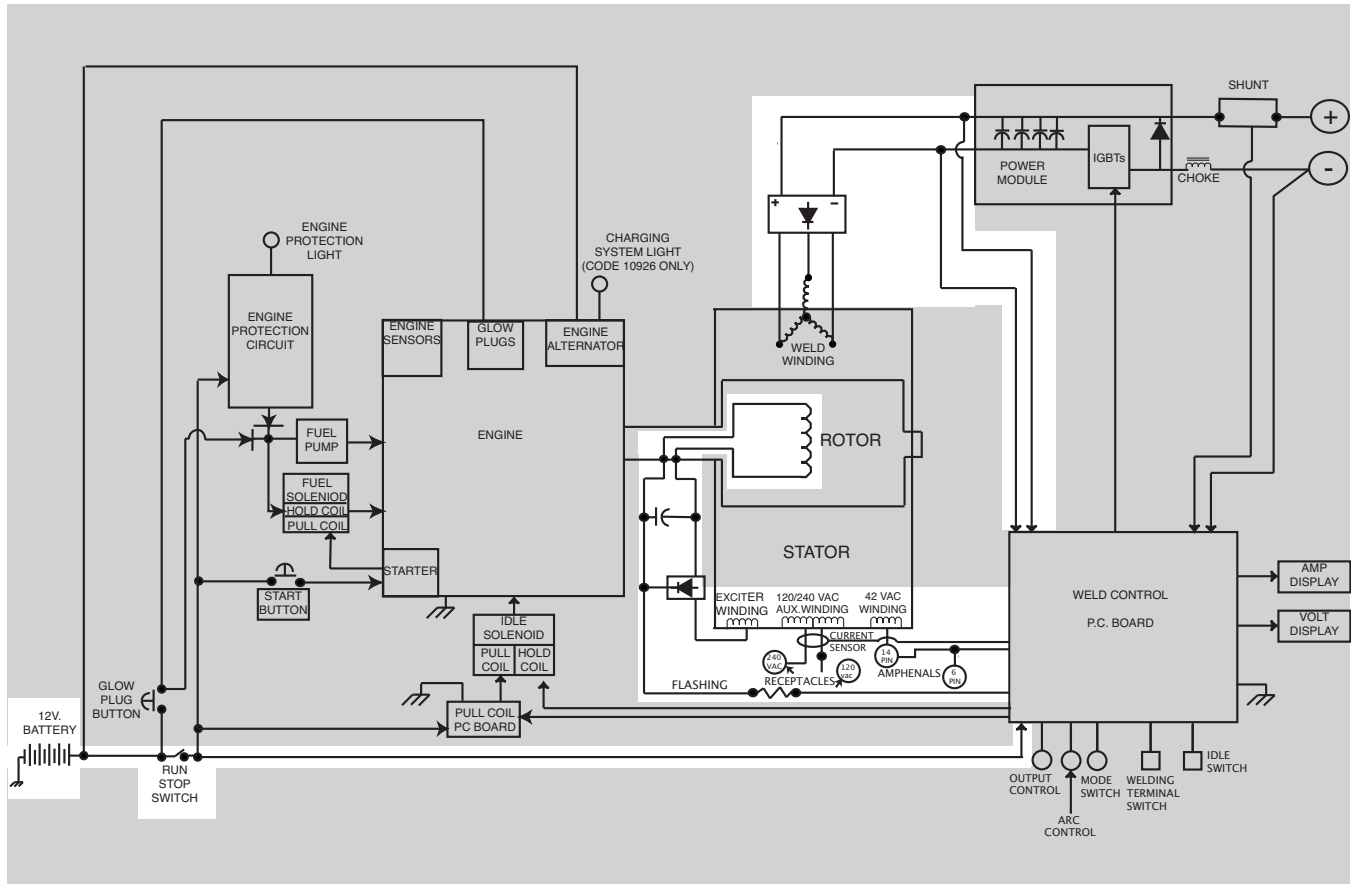
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FIGURE E.4 – GENERATING POWER & OUTPUT



Generating Power

Flashing:

The battery supplies 12VDC power to the control PC board. When the engine protection light shuts off, the control board allows the 12VDC “flashing” voltage to be applied to the now rotating generator field winding, first passed through a current limiting resistor, then through the brushes and slip rings to frame ground.

Building Output:

The flashing current produces a weak magnetic field in the rotor. This rotating magnetic field begins to generate AC output from all of the stator windings. Output from the 42 VAC exciter winding is rectified by a diode bridge, then filtered by a capacitor and fed back into the rotating field winding, through the brushes, making the magnetic field stronger. This stronger magnetic field then produces higher voltage from the stator windings, which feeds back to the rotor, making its magnetic field even stronger.

This process of strengthening the magnetic field through feedback from the output continues to increase

the output of the main generator until the design voltage is reached. The output of the machine depends on engine RPM and rotor current.

The field voltage is now considerably higher than the flashing voltage that was used to start the generating process. Circuitry in the control PC board blocks that higher field voltage from intruding into the 12VDC battery system.

AC output:

The generator is now producing sufficient AC power from all four of the windings. These windings consist of 60 to 65 VAC three phase weld winding, a 120/240 VAC auxiliary power winding, a 42 VAC exciter winding, and a 42 VAC wire feeder power winding.

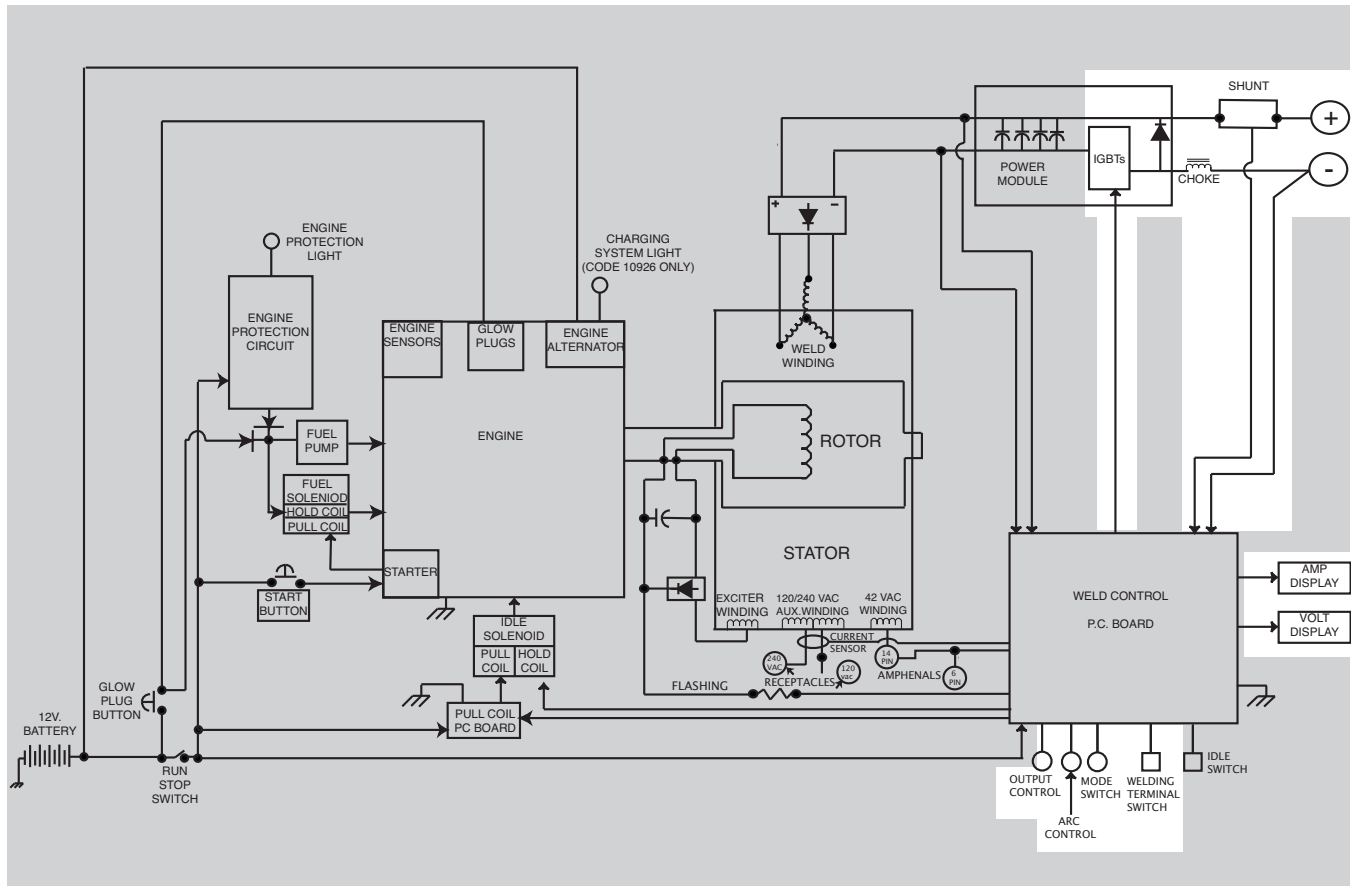
DC output:

The output from the three phase weld winding is converted to DC by a three phase output rectifier then filtered by four large capacitors located on the power module assembly. This produces about 90VDC power that supplies the IGBTs on the power module and the weld control PC board.

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FIGURE E.5 – WELD POWER & CONTROL



Weld Power and Control

Weld Power:

Approximately 90VDC power, as described earlier under the heading “Generating Power”, is supplied to the IGBT’s, (See IGBT Operation) and to the control circuitry in the power module, as well as the weld control PC board.

The IGBT’s control the weld output by switching the weld power on and off using a 20 KHz PWM (Pulse Width Modulation) signal from the control PC board. This PWM signal varies the ratio of on and off time, thereby controlling the power passing through to the welding arc. (See *Pulse Width Modulation*)

The DC power that is being controlled by the IGBT’s is now applied to the choke. The choke is a heavy conductor wound around an iron core. This device stores power and tends to resist any change to current flow. During the IGBT off cycle, the choke begins to discharge through a freewheeling diode, on the power module. This diode provides the necessary current path, allowing the choke to use its stored power to maintain a smooth flow of current to the welding arc during the IGBT’s off times. (See *Chopper Technology Fundamentals*)

Weld Control and Feedback:

The operator provides input to the weld control circuitry by means of the output control and arc control potentiometers, and the mode switch. These operator inputs are used by the microprocessor, together with pre-programmed internal parameters, current feedback from the shunt, and voltage feedback from the output studs, to control the IGBT’s via the PWM signal discussed earlier.

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THEORY OF OPERATION

Remote output control:

The Weld control PC board automatically detects when a remote control potentiometer is connected to either of the Amphenols. In "CC-STICK", "DOWN-HILL PIPE" or "CV-WIRE" modes, the front panel output control is disabled when a remote control device is connected. In "TOUCH START TIG" mode, the front panel output control potentiometer is used to set the maximum output value. The remote potentiometer varies the output from minimum to maximum value set by the front panel control.

Electronic Output Contactor:

The operator also has the ability to control when power is delivered to the output studs. This is accomplished by signaling the control PC board when to send the PWM signal to the chopper module. Turning the PWM signal on or off has the same effect as activating or deactivating an output contactor, and is accomplished by closing the circuit between the #2 and #4 leads. The welding terminal switch closes this circuit when it is placed in the "WELD TERMINALS ON" position. When the switch is placed in the "REMOTELY CONTROLLED" position, the circuit is closed by a TIG foot pedal, a control cable type wire feeder, or other remote control devices that can be plugged into either the 6 pin or the 14 pin Amphenol.

Digital Meters:

Two identical digital displays are connected to the control PC board and are used to indicate weld outputs Amps and Volts. When no current is flowing, the machine is in "preset" mode and only one of the displays will be active. If mode switch is set for "CV-WIRE", only the volts display will be active; in all other modes, only the amps display will be active. When weld current is flowing, both displays will indicate actual weld volts and amps.

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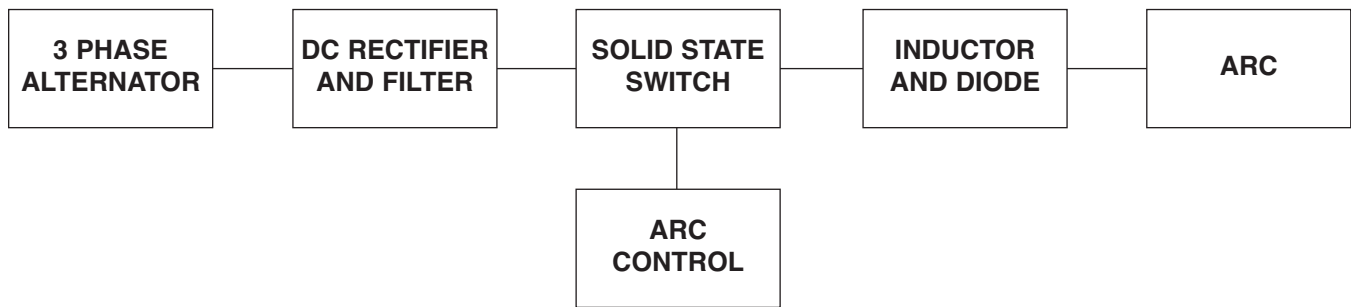
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THEORY OF OPERATION

CHOPPER TECHNOLOGY FUNDAMENTALS

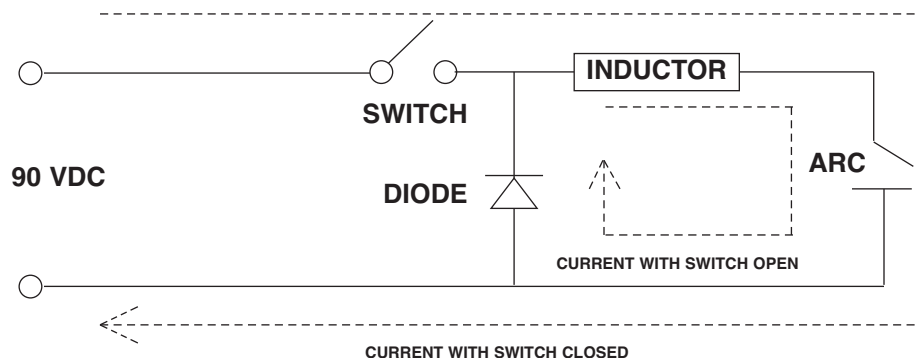
The new era of welding machines such as the Ranger 305D employ a technology whereby a DC source is turned on and off (chopped up) at high speed, then smoothed through an inductor to control an arc.

Hence the name "Chopper." The biggest advantage of chopper technology is the high-speed control of the arc, similar to the inverter machines. A block diagram for this is as follows:



In this system, the engine drives a three-phase alternator, which generates power that is rectified and filtered to produce about 90 VDC. The current is applied through a solid state switch to an inductor. By turning

the switch on and off, current in the inductor and the arc can be controlled. The following diagram depicts the current flow in the system when the switch is open and closed:



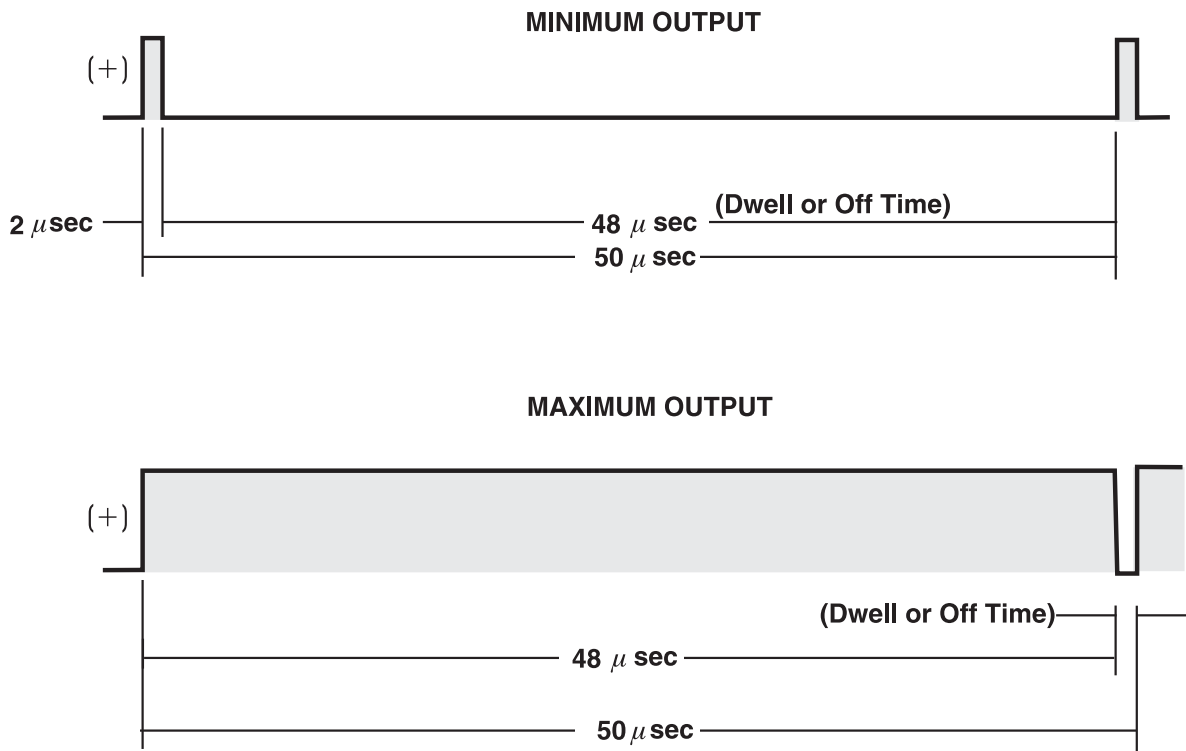
When the switch is closed, current is applied through the inductor to the arc. When the switch opens, current stored in the inductor sustains flow in the arc and through the diode. The repetition rate of switch closure is 20Khz, which allows ultra-fast control of the arc. By

varying the ratio of on time versus off time of the switch (Duty Cycle), the current applied to the arc is controlled. This is the basis for Chopper Technology: Controlling the switch in such a way as to produce superior welding.

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FIGURE E.6 – IGBT OPERATION



PULSE WIDTH MODULATION:

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation (PWM) is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

MINIMUM OUTPUT:

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 50-microsecond time period.

The positive portion of the signal represents one IGBT group conducting for 2 microseconds. The dwell time (off time) is 48 microseconds. Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT:

By holding the gate signals on for 48 microseconds and allowing only 2 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more darkened area under the curve, the more power is present.

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TROUBLESHOOTING & REPAIR

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled “PROBLEM” (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into four main categories: Output Problems, Function Problems, Engine Problems, and Welding Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled “POSSIBLE AREAS OF MISADJUSTMENT(S)”, lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled “Recommended Course of Action” lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this section. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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TROUBLESHOOTING & REPAIR

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

ELECTRIC SHOCK can kill.



Have an electrician install and service this equipment. Turn the machine OFF before working on equipment. Do not touch electrically hot parts.

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

PC Board can be damaged by static electricity.



ATTENTION
Static-Sensitive
Devices
Handle only at
Static-Safe
Workstations

Reusable
Container
Do Not Destroy

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.

- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.
- If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
 - a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
 - b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
POWER OUTPUT PROBLEMS		
Major mechanical or electrical damage is evident.	1. Contact your local Lincoln Authorized Field Service Facility.	1. Contact the Lincoln Electric Service Department at 1-888-935-3877.
No welding output or auxiliary power. The engine operates normally.	1. Check for loose or faulty connections at any leads, cables or cords attached to either the auxiliary output receptacles and/or the weld output terminals.	1. Check the brushes for wear and proper contact to the rotor slip rings. 2. Perform the Brush and Slip Ring Service procedure. 3. Perform the Rotor Voltage Test. 4. Perform the Stator Voltage Test.
No welding output in any mode. The auxiliary output is normal. The engine operates normally.	1. Place the Welding Terminals switch in the "WELD TERMINALS ON" position. If the problem is solved, the fault may be in the external control cable, or the attached wire feeder, amptrol, arc start switch, etc. (if used) 2. With the engine at high idle (3650RPM), the machine in the CC-STICK mode, the output control at maximum, and the welding terminals switch in the "WELD TERMINALS ON" position; check for the presence of approximately 58VDC, OCV (open circuit voltage) at the weld output terminals. 3. If the correct OCV is present at the welding output terminals, check the welding cables, connectors, work clamps, electrode holder, etc. for loose or faulty connections.	1. Check for damaged conductors or faulty connections on the heavy current carrying leads that connect the output studs to the Chopper module and to the output Rectifier. Also Check the shunt and choke assemblies for damage and faulty connections. 2. Perform the Chopper Module Function Test.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
POWER OUTPUT PROBLEMS		
<p>No auxiliary power at one or more receptacles, or at the 14 pin Amphenol receptacle. Weld output is normal, and the engine operates normally.</p>	<ol style="list-style-type: none"> 1. Check for loose or faulty connections at any cords attached to the auxiliary output receptacles, or to the 14 pin Amphenol receptacle. 	<ol style="list-style-type: none"> 1. Check for tripped circuit breakers and/or tripped GFCI receptacles. 2. Perform the Stator Voltage Tests.
<p>The machine has low welding output and low auxiliary output.</p>	<ol style="list-style-type: none"> 1. The engine RPM may be too low. 2. The brushes may be worn, sticking, or poorly seated. 	<ol style="list-style-type: none"> 1. The high idle speed may be low. Perform the Engine Throttle Adjustment Test. <p>NOTE: If the engine high idle RPM is normal, but the engine slows down excessively when the machine is placed under a normal welding or auxiliary load. The engine may have lost horsepower, and may be in need of service.</p> <p>NOTE: Normal Full load engine speed should be about 3500 RPM.</p> <ol style="list-style-type: none"> 2. Inspect and, if necessary, service the brushes and slip rings per the Brush and Slip Ring Service procedure. 3. Perform the Rotor Voltage Test. 4. Perform the Stator Voltage Test.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The machine will weld, but the welding arc is "cold". The engine runs normally and the auxiliary power is normal.</p>	<ol style="list-style-type: none"> 1. Make sure the machine is properly set for the electrode and process being used. Check electrode size, mode switch setting, amps or voltage setting. If gas is used, make sure the correct type of gas is used and that the gas flow is set correctly. 2. Make sure that the process does not demand more power than the machines able to produce. 3. If the current seems about right, but the electrode easily sticks in the puddle, try increasing the "ARC CONTROL" setting. 4. Check for loose or faulty connections at the weld output terminals and welding cable connections. 5. Check for adequate connection between the work cable and the work piece. The work cable should be attached to clean metal, as close to the weld area as practical. The work clamp must be in good condition and have adequate spring tension. 6. The weld cables may be too long, and/or too small, causing excessive voltage drop between the machine and the arc. 	<ol style="list-style-type: none"> 1. The engine RPM may be too low. Perform the Engine Throttle Adjustment test. 2. Connect the machine to a resistive load bank. Connect an accurate ammeter and volt meter to the output of the machine, (Meters are often built into modern load banks.) Connect a means of measuring the engine RPM. (See the Engine Throttle Adjustment Test for recommended methods of measuring engine RPM. 3. Place the mode switch in the "CC-STICK" position, turn the output control fully clockwise, place the idle switch in the "HIGH IDLE" position. Set the weld terminals switch to "WELD TERMINALS ON" position. 4. Make sure that nothing is plugged into either of the Amphenol receptacles. 5. Start the machine and allow the engine to run for about a minute. Apply a load with the resistance load bank, and adjust until the external meters read about 305 amps and about 29 VDC. If the machine will not produce this output, apply as much load as possible.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The machine will weld, but the welding arc is “cold”. The engine runs normally and the auxiliary power is normal. (continued)</p>	<p>7. The weld cables may be coiled, or wrapped around metal reels or racks. This can cause excessive electrical inductance in the weld circuit. Try welding after uncoiling the cables, or disconnect the existing cables and weld with a set of adequately sized, short test cables.</p>	<p>6. With the above load applied, the engine should maintain at least 3350 RPM. If the engine cannot maintain this RPM, make sure there is an adequate supply of clean, fresh fuel. Check the fuel filter and the air filter. Replace any filter that is dirty or damaged. If this doesn't help, the engine should be serviced.</p> <p>7. Compare the volt and amp readings shown on the external meters with the readings displayed on the machine's front panel. If these readings differ significantly, perform the WELD CONTROL FEEDBACK TEST.</p> <p>8. If the maximum weld output cannot be obtained even though the engine maintains correct RPM, and the front panel displays are reading accurately. Check for damaged conductors and loose or damaged connections at each of the large weld-current carrying conductors that connect the stator, output rectifier, chopper module, choke, shunt, and output terminals. See the wiring diagram.</p> <p>9. If all of the these connections are good, perform the Rotor Voltage Test, the Stator Voltage Test, the Output Rectifier Test, and the Power Module Resistance Test.</p> <p>10. Perform the CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST. Perform the REMOTE RECEPTACLE RESISTANCE TEST. Replace the weld control PC board.</p>

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The machine welds, but it will not maintain a steady output. The arc may suddenly get hotter or colder.</p>	<ol style="list-style-type: none"> 1. This condition may be normal in the Downhill Pipe Mode. The Downhill Pipe Mode allows the arc current to increase and decrease slightly as the arc length changes. 2. Check that the electrode used is of good quality, dry, and free of contamination. Try using some new Lincoln electrode, and setting the machine per the Lincoln's recommendations for that product. 3. If shielding gas is used, check that the correct gas is being used, and that the gas flow is set correctly. Check the gas system for damaged, pinched or leaking hoses. 4. Check for loose or faulty connections at the weld output terminals and welding cable connections. 5. Check for adequate connection between the work cable and the work piece. The work cable should be attached to clean metal, as close to the weld area as practical. The weld clamp must be in good condition and have adequate spring tension. 6. The weld cables may be too long, and/or too small, causing excessive voltage drop between the machine and the arc. 	<ol style="list-style-type: none"> 1. The engine may not be maintaining correct RPM. Perform the Engine Throttle Adjustment Test. Make sure the engine has an adequate supply of clean, fresh fuel. Check the fuel and air filters, replace if necessary. 2. If the engine still fails to maintain correct RPM, the engine will need to be serviced. 3. Check the internal cables and leads that connect the weld winding of the stator, chopper module, shunt, choke and the output terminals. See the wiring diagram. Look for any damaged conductors or faulty connections. 4. There may be poor connections in the control wiring at the weld control PC board or the chopper board. Pull each plug from the weld control PC board and thoroughly inspect the terminals in both the plugs and the PC board receptacles. Make sure the connections are clean and that the pins are properly seated in the plastic plug housing. Check for loose or damaged pins and faulty crimp connections. 5. Check for damaged wiring and poor connections in leads 13, 14, 23, and 25 between the chopper module and the weld control PC board.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The machine welds, but it will not maintain a steady output. The arc may suddenly get hotter or colder.(continued)</p>	<p>7. The weld cables may be coiled, or wrapped around metal reels or racks. This can cause excessive electrical inductance in the weld circuit. Try welding after uncoiling the cables, or disconnect the existing weld cables and attach a set of adequately sized, short test cables.</p>	<p>6. The output control or arc control potentiometers may be defective or grounded. The mode switch may also be faulty. Perform the Control Potentiometer and Mode Switch Resistance Test.</p> <p>7. The Amphenol receptacles may be contaminated or defective. Perform the Remote Receptacle Resistance Test.</p> <p>8. Replace the weld control PC board.</p>
<p>The weld output cannot be adjusted with the front panel output control knob in one or more weld modes. The weld output terminals have normal OCV (Open Circuit Voltage), The AC auxiliary power is normal and the engine operates normally.</p>	<p>1. Remote control devices completely disable the front panel control in all modes except touch start TIG mode. Make sure nothing is plugged into either of the Amphenol receptacles.</p> <p>2. Check for dirt or moisture contamination in either 6 pin or the 14 pin amphenol receptacle.</p>	<p>1. Perform the Remote Receptacle Resistance Test.</p> <p>2. The output control potentiometer may be defective.</p> <p>3. Perform the Control Potentiometer and Mode Switch Resistance Test.</p>

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The machine front panel output control is still active when the remote control unit is connected to one of the Amphenol Receptacles.</p>	<ol style="list-style-type: none"> 1. The condition is normal in "Touch Start TIG" mode. See the operators' manual. 2. The remote control unit may be defective. 3. Check the Amphenol receptacles. Look for damaged or corroded contact pins in the receptacle and in the plug of the remote control unit. 	<ol style="list-style-type: none"> 1.. Check plug #P1 on the control PC board. Plug should be properly seated and pins in both the plug and the PC board jack must be clean and fit tightly together. 2. There may be a poor connection between the weld control PC board and the Amphenol receptacles. Check for continuity between the following terminals. See Wring diagram and control connection diagram. P1-10 to 6 pin Amphenol pin "C" and to 14 pin Amphenol pin "G". P1-11 to 6 pin Amphenol pin "A" and to 14 pin Amphenol pin "E". P1-14 to 6 pin Amphenol "B" and to 14 pin Amphenol pin "F". 3. The weld control Pc board may be defective.
<p>The machine seems to be locked into the "CC-STICK" mode of operation.</p>	<ol style="list-style-type: none"> 1. Check the position of the WELD MODE selector switch. The switch should cleanly snap into each mode position, and should not feel gritty or get hung-up between positions. 	<ol style="list-style-type: none"> 1. Check that plug P-7 is fully seated into the weld control PC board socket. See Control Inner-Connection diagram. Check for corroded, dirty, or damaged Molex terminals in plug P-7, also check for similar problems in socket J-7 on the weld control PC board. Check the wiring between the control PC board and the mode switch. look for poor crimp and solder connections as well as damaged wiring or insulation. See wiring diagram. 2. Perform the Control Potentiometer and Mode Switch Test. 3. The Weld control PC board may be defective.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELD OUTPUT PROBLEMS		
<p>The arc quality is poor with excessive spatter. The arc heat can be controlled and maintained normally, the auxiliary output is normal, and the engine operates normally.</p>	<ol style="list-style-type: none"> 1. The arc Control may be set too high. Try using a lower setting. 2. The output control may be set too high for the electrode being used. Try welding at a lower setting. 3. Check that the electrode used is of good quality, dry, and free of contamination. Try using some new Lincoln Electrode, and setting the machine per the Lincoln's recommendations for that product. 4. If shielding gas is used, check that the correct gas is being used, and that the gas flow is set correctly. Check the gas system for damaged, pinched or leaking hoses. 5. The weld cables may be coiled, or wrapped around metal reels or racks. This can cause excessive electrical inductance in the weld circuit. Try welding after uncoiling the cables, or disconnect the existing weld cables and attach a set of adequately sized, short test cables. 	<ol style="list-style-type: none"> 1. Check that the weld circuit is not grounded. With the engine off, check the resistance between chassis ground and the weld output terminals. The resistance should be very high, a reading of 500,000 (500k) ohms or higher is acceptable. 2. The weld control system may be grounded or malfunctioning. Perform the Control Potentiometer and Mode Switch Test, and the Remote Receptacle Resistance Test. 3. The Chopper module may be defective. Perform the Chopper Module Resistance Test.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
MISC. WELD ISSUES		
<p>The machine welds normally in all modes and the range of weld output seems normal, but one or both of the front panel displays is blank. displaying an obviously incorrect value, or only parts of numbers are illuminated.</p>	<ol style="list-style-type: none"> 1. It is normal for one of the displays to be off when there is no load across the weld output terminals. In CV-WIRE mode, only the "VOLTS" display will be illuminated, in all other modes only the "AMPS" display will be illuminated. 	<ol style="list-style-type: none"> 1. NOTE: Both the "AMPS" and the "VOLTS" front panel displays use the same part numbered display unit. If one of the digital displays appears to be functioning normally, it can be used to test the weld control PC board output to the malfunctioning display. 2. If the known good display functions normally when plugged in, in place of the malfunctioning display, the weld control PC board is good and only the malfunctioning display unit should be replaced. 3. If the known good display exhibits the same type of problem as the malfunctioning display, the weld control PC board is defective and should be replaced.
<p>A control cable type wire feeder does not function when connected to the 14 pin amphenol receptacle. Machine operates normally in CC-STICK mode, and has normal AC auxiliary output.</p>	<ol style="list-style-type: none"> 1. Check circuit breaker CB1 if using a 115-120 VAC wire feeder. Check CB8 if using a 42 VAC wire feeder. Reset circuit breaker if tripped. 2. Check the Amphenol receptacle for damaged, corroded, or dirty contact pins. 3. The wire feeder control cable may be defective. 4. The wire feeder may be defective. 	<ol style="list-style-type: none"> 1. Use a volt meter to check for the presents of supply voltage at the 14 pin Amphenol receptacle. 115-120 VAC power is supplied through pins A and J, 42 VAC power is supplied through pins 1 and K. 2. NOTE: Be careful that meter probes do not deform or damage the contact pins in the Amphenol receptacle. 3. Perform the STATOR VOLTAGE TEST.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
MISC. WELD ISSUES		
<p>An Across-the-arc type wire feeder does function when connected to the weld output of the machine. The machine operates normally in CC-STICK mode, and has normal AC auxiliary output.</p>	<ol style="list-style-type: none"> 1. Check that the welding terminal switch is in the "WELD TERMINALS ON" position. 2. Check that the WELD MODE switch in the correct position for the process being used, typically "CV-WIRE" mode. 3. Check for poor weld cable connections between the feeder and the welder output terminal, and between the work and the other weld output terminal. 4. Check that the wire feeder's work sensing lead is properly connected to the work piece, and is in good condition. 5. The wire feeder may be defective. 	<ol style="list-style-type: none"> 1. Use a volt meter to check for the presents about 58 VDC open circuit voltage (OCV) across the output studs of the machine. 2. If the OCV is low, there may be a problem with the mode switch. Perform the CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST. 3. If there is no OCV, see the troubleshooting section for "No welding output in any mode"

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
The engine will not crank when start button is pushed.	<ol style="list-style-type: none"> 1. Check circuit breaker (CB7). Reset if tripped. 2. Make sure the run/stop switch is in the "RUN" position. 3. Check for loose or faulty battery cable connections. See wiring diagram. 4. The battery may be low or faulty. If the battery is low, recharge it. If the battery will not accept a charge, replace it. 	<ol style="list-style-type: none"> 1. Check wiring and connections at the starter motor, glow plug button, CB7 circuit breaker, run/stop switch, and the start button. See wiring diagram. 2. Check the chassis ground connections between the engine block and the negative battery terminal. 3. Place the run/stop switch to the "RUN" position. Press the start button, while checking for voltage between a good clean chassis ground connection (-) and lead #211(+) at the starter solenoid. See the wiring diagram. 4. If no voltage is present, check the start button, the run/stop switch, and the CB7 circuit breaker. See the wiring diagram. 5. If battery voltage is present, the starter motor or solenoid may be defective, or the engine may be prevented from turning due to a mechanical failure.
The battery does not stay charged.	<ol style="list-style-type: none"> 1. Check for loose, corroded, or faulty connections at the battery. 2. Check for loose or damaged alternator drive belt. 3. The battery may be faulty. 	<ol style="list-style-type: none"> 1. Perform the ENGINE ALTERNATOR TEST. 2. There may be a defective component or fault wiring, causing a current draw when the run/stop switch is in "stop" position. 3. Check the Run/stop switch, the glow plug button, the alternator and the starter solenoid. Also check for damaged wiring and insulation. 4. If the engine charging system is operating properly but the battery is not staying charged, the battery is defective and should be replaced.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
The engine cranks when the start button is pressed but will not start.	<ol style="list-style-type: none"> The battery voltage may be low. (This condition will normally result in slow cranking speed.) The battery should be checked and recharged if it is not producing adequate voltage, and replaced if it will not accept a full charge. Make sure the glow plug button is pressed while pushing the start button. See the operator's manual, or the operation section of this manual for the proper starting procedure. Make sure the fuel valve on the fuel sediment filter is in the open position. Check that the machine has an adequate supply of fresh, clean fuel. The fuel filter may be clogged. Replace the fuel filter if necessary. Check the oil level. 	<ol style="list-style-type: none"> The fuel solenoid may be faulty or not operating properly. Check lead #231 and perform the Fuel Solenoid Test. The engine may be in need of mechanical repair.
The engine starts, but shuts down immediately when the start button is released.	<ol style="list-style-type: none"> Make sure the glow plug button is pressed while pushing the start button, and held in until the engine protection light turns off, (5 SECONDS MAXIMUM AFTER THE ENGINE STARTS) See the operator's manual, or the operation section of this manual for the proper starting procedure. Check the oil level. Be certain that the engine is not overheated. Check that the machine has an adequate supply of fresh, clean fuel. The fuel filter may be clogged. Replace the fuel filter if necessary. 	<ol style="list-style-type: none"> The fuel solenoid may be faulty or not operating properly. Check lead #225B and perform the Fuel Solenoid Test. See the wiring diagram. The fuel solenoid bypass circuit may be faulty. Check the glow plug button for proper operation. Check lead #233A, and diode bridge D4. See wiring diagram. The engine protection relay may be faulty. The engine may have inadequate oil pressure. The oil pressure switch or coolant temperature switch may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
<p>The engine shuts down shortly after starting.</p>	<ol style="list-style-type: none"> 1. Check for adequate supply of clean, fresh fuel. 2. Check fuel and air filters, replace if necessary. 3. Check oil level, add oil as required, and look for oil leakage. 4. Check for loose or faulty battery cable connections. 	<ol style="list-style-type: none"> 1. The oil pressure switch or coolant temperature switch may be faulty. 2. Check for faulty run/stop switch or engine protection relay. 3. Check for damaged insulation in the wiring between the engine projection relay and the oil pressure and coolant temperature switches. See wiring diagram. 4. Check for poor electrical connections at the run/stop switch, the engine protection relay, the D4 diode bridge, and the fuel solenoid. See wiring diagram. 5. The fuel solenoid may be faulty. Perform the Fuel Solenoid Test.
<p>The engine shuts down shortly after starting and trips the battery circuit breaker, (CB7).</p>	<ol style="list-style-type: none"> 1. Try resetting circuit breaker. If it trips again, do not attempt to use the machine. 2. Contact a Lincoln Authorized Field Service Facility. <p>Note: Repeated tripping and resetting of the circuit breaker can damaged it, or alter its trip point. If the breaker has been tripped and reset many times, it should be replaced.</p>	<ol style="list-style-type: none"> 1. Examine the CB7 circuit breaker, run/stop switch, stop button, Shut-down and idle solenoids, pull coil PC board, engine protection relay, fuel gauge and sender, alternator, and all the wiring connecting these components. Look for any damaged or out of place wiring that may be in contact with other conductors or chassis ground. See the wiring diagram. 2. Perform the Idle Solenoid Test. Perform the Shutdown Solenoid Test. 3. The Pull coil PC board may be defective. Disconnect lead 232 from terminal B1 of the pull coil PC board and insulate it or position it so it does not come into contact with chassis ground or any other conductor. Start the engine; if the engine continues to run and the CB7 circuit breaker does not trip, the pull coil PC board is probably defective and should be replaced.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
<p>The engine will not develop full power.</p>	<ol style="list-style-type: none"> 1. The fuel may be old or contaminated. Supply the engine with fresh, clean fuel. 2. The fuel filter may be clogged; replace the filter if necessary. 3. The air filter may be clogged; replace if necessary. 	<ol style="list-style-type: none"> 1. The engine may be in need of adjustment or repair.
<p>The engine will not idle down to low RPM. The machine has normal weld output and auxiliary power.</p>	<ol style="list-style-type: none"> 1. Make sure the idle switch is in the "AUTO IDLE" position. 2. Make sure there is no external load on the weld terminals or the auxiliary power receptacles. 3. Check for mechanical restrictions in the idler solenoid linkage. 	<ol style="list-style-type: none"> 1. Perform the Idle Solenoid Test. 2. Check for damaged wiring or faulty connections at idle solenoid, the pull coil PC board, the run/stop switch, and the start button. 3. Check for loose or damaged wiring or faulty connections at leads #404 and #215. (Control PC Board P2-4 and P2-5) See Wiring diagram. 4. Set the idle switch in the "AUTO" position. Set the mode switch to the CC-STICK position. Make sure that no lead is applied to either weld output or the auxiliary output. 5. Start the machine and allow it to run for about 30 seconds. 6. Manually move the idle solenoid plunger to the idle position. If the solenoid engages and holds in the idle position, the pull coil PC board is probably defective; replace it.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
		<ul style="list-style-type: none"> 7. If the solenoid does not hold in the low idle position, remove plug P6 from control PC board and wait for about 30 seconds. 8. If the engine drops to low idle, check for damage or a buildup of conductive materials on or around the bypass filter assembly and the output terminals. See wiring diagram. 9. Note: The bypass filter assembly is connected between the output terminals. See wiring diagram. 10. If the engine still does not drop to low idle, the control PC board is probably defective. Replace it.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
<p>The engine will not go to high idle when using auxiliary power. Auxiliary power is normal when the idler switch is in the "HIGH" position. And the automatic idle function works properly when welding.</p>	<ol style="list-style-type: none"> 1. The load on the auxiliary receptacle may be too low. The automatic idle system will not function reliably if the load is less than 100 watts. 2. The device connected to the auxiliary power may be defective; try using another device. 3. Make sure that the connections to the auxiliary devices are tight. 4. Some devices are designed to sense for adequate input power. Products of this type may not turn on due to the low voltage and frequency of the idling machine. If this happens, the current draw will likely be insufficient to activate the automatic idle system. Devices of this type may require that the idler switch be in the "HIGH IDLE" position. 	<ol style="list-style-type: none"> 1. Check that leads #3 and #6 are properly routed through the toroidal current sensor. Each lead must have two turns and must pass through the sensor in opposite directions. See the wiring diagram. The leads should be wrapped tightly and tie-wrapped in place. 2. Check the toroidal current sensor for an signs of damage. 3. Check leads #260 and #261 for poor connections and damage to the conductors and insulation between the toroidal current sensor and the P3 connector on the control Pc board. 4. Unplug plug P3 from the control PC board and check for damaged, dirty, or corroded pins. 5. Measure the resistance of the toroidal current sensor. Measure between P3-3 and P3-4; the meter should read about 10 to 14 ohms 6. If the current sensor is shorted or open, replace it. 7. The control PC board may be defective.
<p>The engine will not go to high idle when striking an arc. The automatic idle system functions normally when using auxiliary power. Welding and auxiliary outputs are normal when the idle switch is in the "HIGH IDLE" position.</p>	<ol style="list-style-type: none"> 1. Check that the welding cables are in good condition and the connections are tight. Make sure that work clamp is attached to clean, bare metal. 	<ol style="list-style-type: none"> 1. The weld control PC board may be defective.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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INSTALLATION

Observe Safety Guidelines detailed in the beginning of this manual.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE AND IDLE PROBLEMS		
The engine will not go into high idle when attempting to strike an arc, or when a load is applied to any of the auxiliary power receptacles. Welding and auxiliary outputs are normal when the idle switch is in the "HIGH IDLE" position.	1. Check that the welding cables and the auxiliary power lead connections are tight.	1. The weld control PC board may be defective.
The engine goes to low idle, but will not stay at low idle.	1. Make sure there are no external loads on either the weld terminals or the auxiliary receptacles. 2. Check that the welding cables and the auxiliary power lead connections are tight and that the insulation is undamaged.	1. The idler solenoid linkage may be damaged or out of adjustment. Make sure the solenoid plunger is able to fully seat against the internal stop of the solenoid coil assembly. 2. The low idle RPM may be too low. Perform the Engine Throttle Adjustment Test . 3. The solenoid hold coil power circuit may be faulty. Check wiring and connections on lead #210A and lead #215. 4. The weld control PC board may be defective.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

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CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the case sheet metal cover and engine access doors.

MATERIALS NEEDED

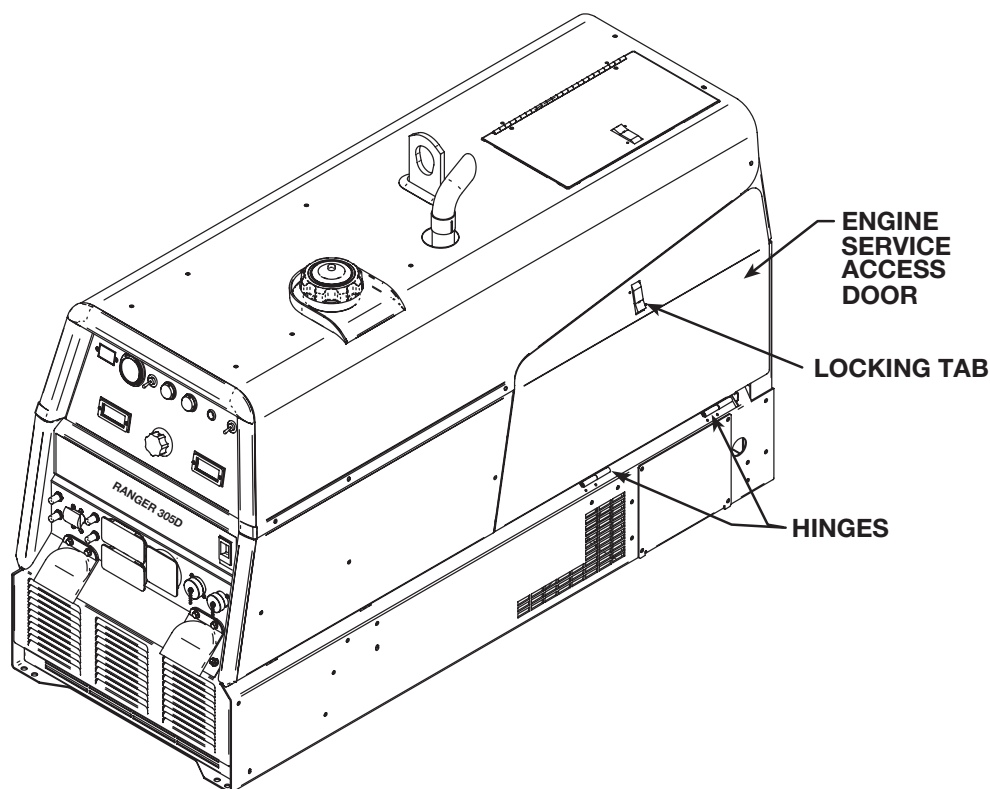
Miscellaneous hand tools
Rubber mallet

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CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

FIGURE F.1 – DOOR REMOVAL



REMOVAL PROCEDURE

1. Turn the engine off.
2. Unlatch and open the engine service access doors.
3. To remove each door, partially close the door until the locking tabs at the hinges disengage from the slots in the base. Hold the door at this angle while sliding it off the hinge. It may be necessary to lightly tap the door with a rubber mallet to free it from the hinge. See Figure F.1.
4. Remove the exhaust pipe extension.
5. Remove the cover seal from around the lift bail.
6. Remove the sheet metal and machine screws holding the case cover in place.
7. Remove the sheet metal screws from the right and left case sides. lift the case cover slightly, then tilt each side back and lift up to free the bottom tabs from their slots.

8. Lift the case cover off the machine.

NOTE: It is necessary to remove the fuel cap in order to take the case cover off the machine. Screw the cap back on when working on the Ranger 305D.

REPLACEMENT PROCEDURE

1. Install the right and left case sides and screw them in place.
2. Remove the fuel cap, then carefully set the case cover in place. Replace the fuel cap and the lift bail cover seal.
3. Install the exhaust pipe extension.
4. Install the screws that hold the case cover in place.
5. Install each door by positioning it as described in step 3 of the removal procedure, then slide it fully on the hinge.
6. Close and latch the doors.

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CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will insure that the large capacitors in the chopper module have been discharged. This procedure should be performed whenever work is to be attempted on or near the chopper module.

MATERIALS NEEDED

- Miscellaneous hand tools
- Volt/Ohmmeter
- Resistor (25-1000 ohms and 25 watts minimum)
 - Lincoln part #S01404-114 works well for this purpose
- Jumper leads
- Wiring Diagram

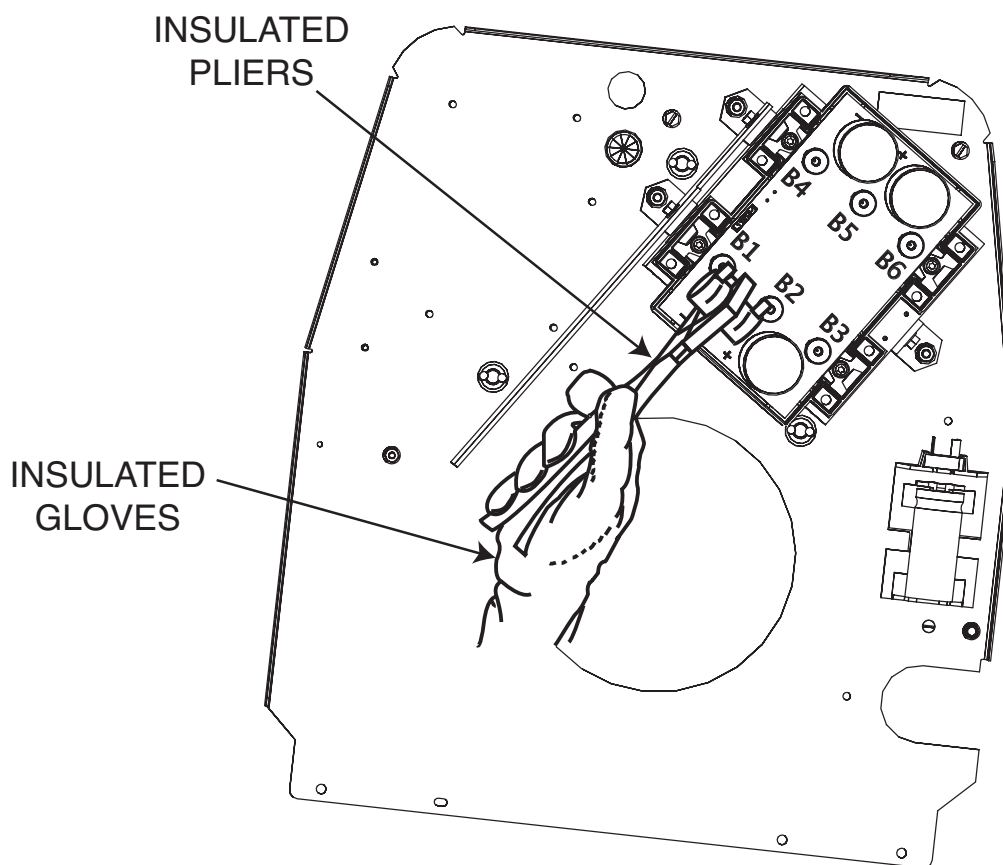
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CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.2 – CHOPPER MODULE CAPACITOR TERMINAL DISCHARGE



TEST PROCEDURE

1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure.

NOTE: It is necessary to remove the fuel cap in order to take the case cover off the machine. Be sure the fuel cap is ON when discharging the chopper module capacitors.

3. Locate the chopper module and capacitor assembly on the inner machine baffle. See Figure F.2 and the Wiring Diagram.

NEVER USE A SHORTING STRAP TO DISCHARGE CAPACITORS. If the Lincoln recommended resistor, or an equivalent resistor is used, the capacitors can be discharged by holding the resistor with insulated pliers and using the resistor terminals to bridge Chopper Module terminals B1 to B2, and B4 to B5. DO NOT TOUCH THE TERMINALS OR METAL PARTS OF THE PLIERS WITH YOUR BARE HANDS. Hold the resistor in place for about 10 seconds.

If another type of resistor is used, jumper leads may need to be attached to the resistor. The leads can then be used to connect terminals B1 to B2, and B4 to B5.

4. Using the volt/ohmmeter, check the voltage across B1 and B2, then B4 and B5. It should be zero volts in both cases.

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TROUBLESHOOTING & REPAIR

FUEL SHUTDOWN SOLENOID TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the shutdown solenoid resistance values are normal, and also determine if it will function normally when energized with 12 VDC.

MATERIALS NEEDED

- Wiring Diagram
- Volt/Ohmmeter
- Miscellaneous hand tools
- 12 volt D.C. power source, (an automotive battery works well)

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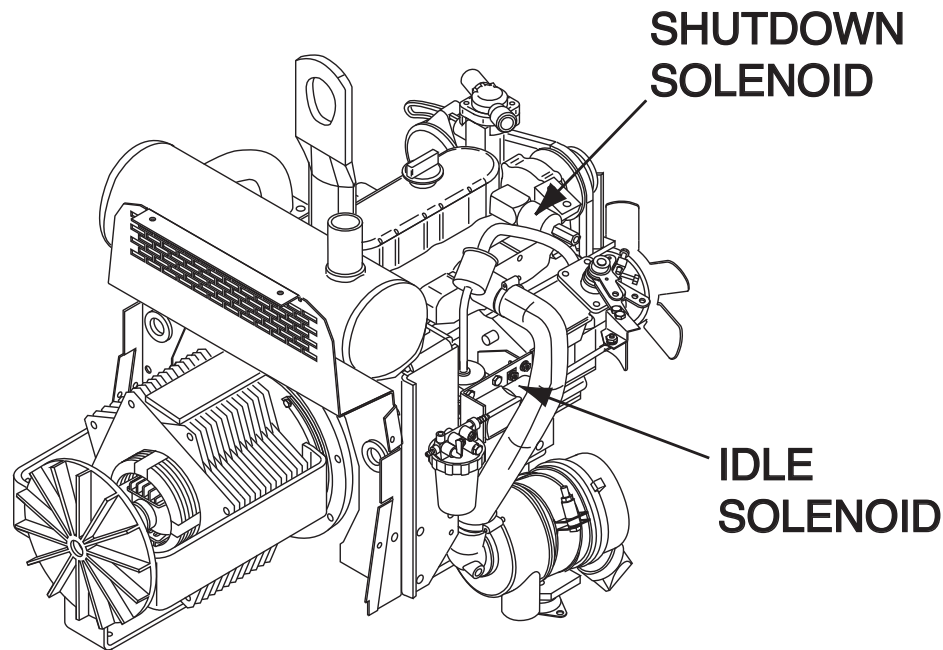
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FUEL SHUTDOWN SOLENOID TEST (*continued*)

FIGURE F.3 – FUEL SHUTDOWN SOLENOID LOCATION



TEST PROCEDURE

1. Turn the engine off.
2. Open the right side engine service access door.
3. Locate the fuel solenoid, located on top of the engine.
4. Locate and unplug harness connection P/J 73. Cut any necessary cable ties. **See Figure F.4.** See Wiring Diagram.
5. Using the Ohmmeter, check the pull-in coil resistance, (black wire to white wire). The normal resistance is less than 0.5 ohms. Check the hold-in coil resistance, (black wire to red wire). The normal resistance is approximately 11 ohms. Check the Resistance between the black wire and a clean, unpainted chassis ground. The resistance should be very high, 500,000 Ohms or more. If any of the above resistance values are incorrect, the solenoid may be faulty. Replace.
6. Using an external 12VDC supply, apply voltage to the pull-in coil leads, (black-) to (white+). The solenoid should activate. REMOVE THE VOLTAGE immediately to avoid damaging the solenoid.

Apply 12VDC to the hold coil, leads, (black-) to (red+) While the voltage is applied, manually move the solenoid to the fuel on position. The solenoid plunger should hold this position until the voltage is removed.

If either coil does not operate as described, check for mechanical restrictions or other problems with the linkage.

If the linkage is intact and the solenoid does not operate correctly when 12VDC is applied, the solenoid may be defective. Replace.

Re-connect fuel solenoid and replace any previously removed cable ties.
7. If finished testing, close the engine service access doors.

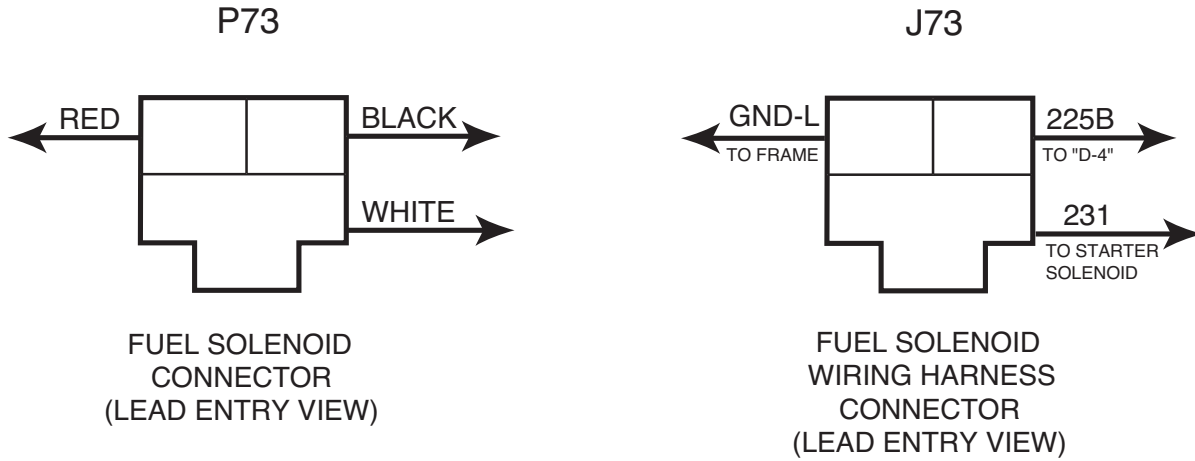
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TROUBLESHOOTING & REPAIR

FUEL SHUTDOWN SOLENOID TEST *(continued)*

FIGURE F.4 – FUEL SOLENOID CONNECTIONS



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TROUBLESHOOTING & REPAIR

ENGINE THROTTLE ADJUSTMENT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

If the machine output is low or high, this test will determine whether the engine is operating at the correct speed (RPM) during both HIGH and LOW idle conditions. You can check RPM using a strobe-tach, a frequency counter, or a vibratach. Directions for adjusting the throttle to the correct RPM are given.

MATERIALS NEEDED

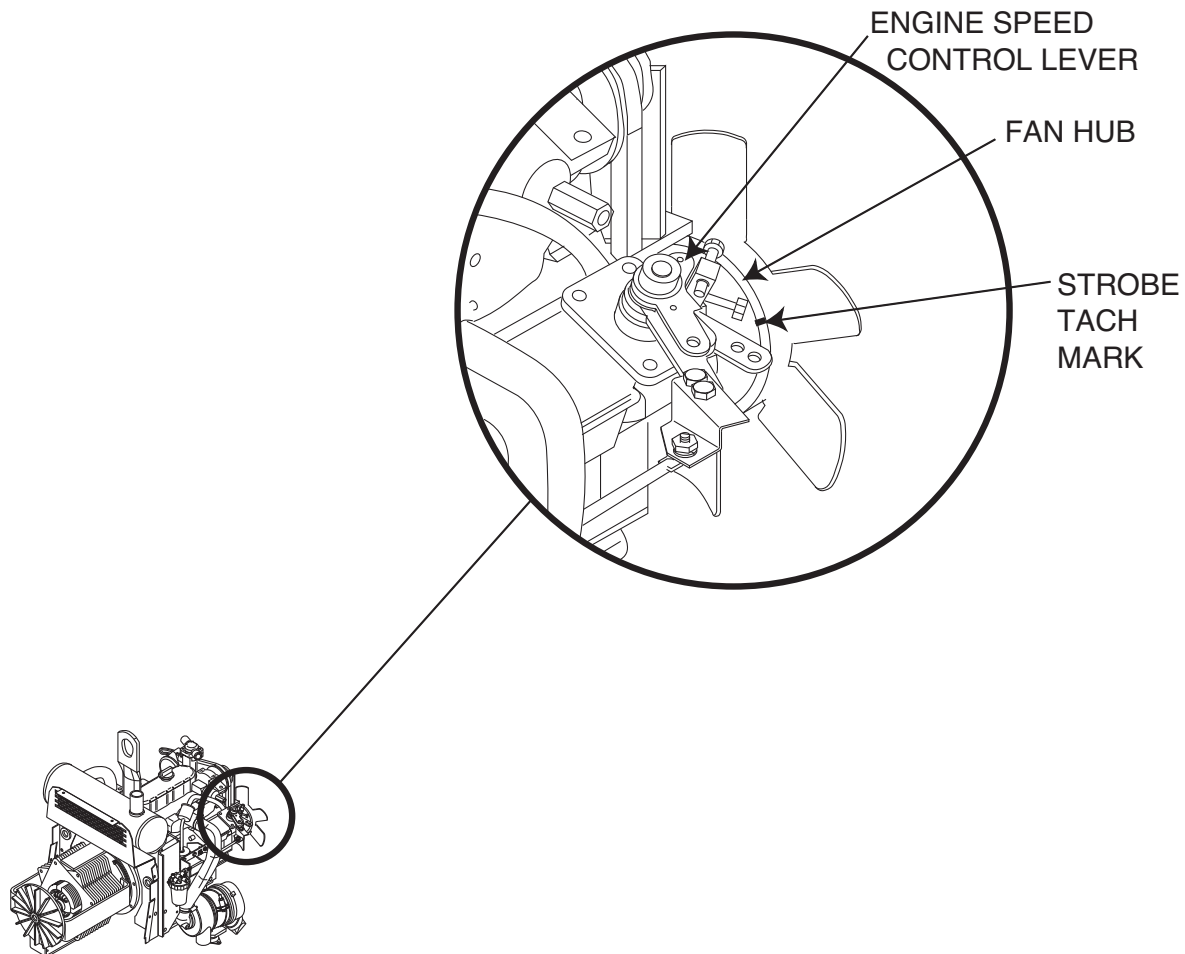
Miscellaneous hand tools and metric wrench set
High visibility marker
Strobe-tach, frequency counter, or vibratach

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ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.5 – STROBE MARK LOCATION

**TEST PROCEDURE****Strobe-Tach Method**

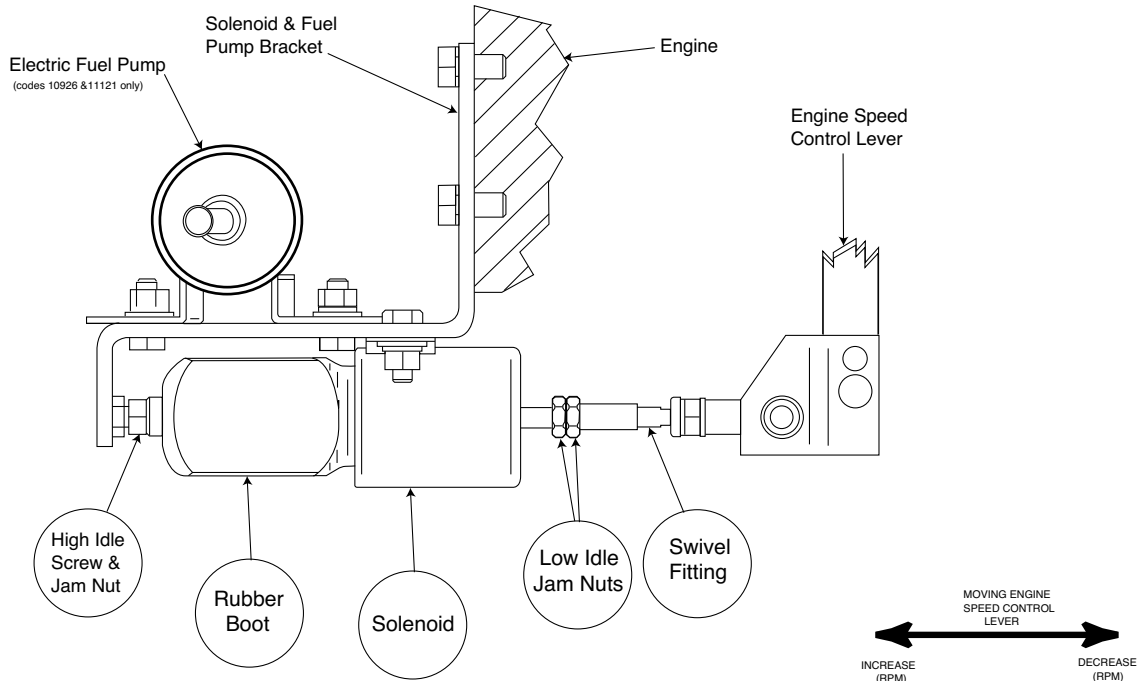
1. Turn the engine off
2. open the top and right side engine service access doors.
3. Place a highly visible mark on the engine cooling fan hub. See Figure F.5.
4. Connect the strobe-tach according to the manufacturer's instructions.
5. Start the engine and place the idle switch in the "HIGH IDLE" position. Make sure that there is no load on the machine.
6. Direct the strobe-tach light on the fan hub that had been marked earlier, and synchronize the light with the rotating mark. See the strobe-tach manufacturer instructions.
The tach should read between 3625 and 3675 RPM.
7. Move the idle switch to the "AUTO IDLE" position and wait for the idle solenoid to energize, and the engine RPM to drop and stabilize at the low idle RPM.
8. Synchronize the strobe-tach to read the low idle RPM.
If either of the readings is incorrect, proceed to the "THROTTLE ADJUSTMENT PROCEDURE" later in this section.

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ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.6 – SOLENOID



- Solenoid viewed from above and shown in High Idle position •

Frequency Counter Method

NOTE: A dedicated frequency counter can be used for this test, but many high quality digital multimeters also have this function, and can be easily utilized. See the manufacturer instructions for your frequency counter or multimeter.

1. Set your frequency counter per the meter manufacturer instructions, and plug it into one of the 120VAC auxiliary receptacles.
2. Start the engine and place the idle switch in the "HIGH IDLE" position. Make sure that there is no load on the machine.

The frequency should read between 60.5 and 61.5 Hz.

3. Move the idle switch to the "AUTO IDLE" position and wait for the idle solenoid to energize, and the engine RPM to drop and stabilize at the low idle RPM.

The frequency should read between 40 and 42 Hz.

If either of the readings is incorrect, proceed to the "THROTTLE ADJUSTMENT PROCEDURE" later in this section.

NOTE: For the Ranger 305D, and any other Lincoln Electric 3600 RPM (2 Pole) machine, engine RPM can be determined by multiplying the frequency, in Hz. By 60. (Example: 60 Hz * 60 = 3600RPM)

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ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

Vibratach Method

A Vibratach is used to measure the vibrations caused by the running engine. It can be positioned anywhere where the engine vibration is reasonably strong. The best results will likely be obtained by opening the top engine cover and placing the Vibratach directly against the top of the engine.

Read and understand the manufacturer's instructions for the Vibratach.

1. Start the engine and place the idle switch in the "HIGH IDLE" position. Make sure that there is no load on the machine.
2. Position and adjust the Vibratach; it should read between 3525 and 3675 RPM.
3. Move the idle switch to the "AUTO IDLE" position and wait for the idle solenoid to energize, and the engine RPM to drop and stabilize at the low idle RPM.
4. Position and adjust the Vibratach; it should read between 2400 and 2500 RPM.

If either of the readings is incorrect, proceed to the "THROTTLE ADJUSTMENT PROCEDURE" later in this section.

THROTTLE ADJUSTMENT PROCEDURE

IMPORTANT: Both the high and low idle settings are adjusted at the solenoid. **DO NOT ATTEMPT TO ADJUST THE STOP SCREWS ON KUBOTA ENGINE.**

The high speed stop screw on the engine is for over speed protection only. It is set to 3800 RPM at the Kubota factory and is wire locked in place to prevent tampering.

1. Check that the linkage attaching the solenoid to the engine speed control lever is properly aligned and in good condition. It is more important that the solenoid linkage be more precisely aligned when in the high speed (de-energized) position).
2. Check to be sure the spring located inside the rubber boot is not broken or missing. In the default, (de-energized) position the spring should be holding the solenoid in the high speed position. **See Figure F.6.**

NOTE: Low idle RPM must be set, and the adjustment nuts tightened, before the high idle RPM is adjusted.

Low Idle adjustment:

1. With engine running and no load applied to the machine, place the idle switch in the "AUTO IDLE" position. Wait for the idle solenoid to energize and the engine speed to drop and stabilize to low idle RPM.
2. If the low idle RPM requires adjustment, loosen the low idle adjustment jam nuts. Turn both nuts so they are clear of the swivel fitting. Rotate the swivel fitting until the engine speed has been set to between 2400 and 2500 RPM. Hold the swivel fitting in position while tightening the first jam nut against the swivel fitting, and then tighten the second jam nut against the first. **See Figure F.6.**
3. Re-check the low idle RPM, and then proceed to the high idle adjustment.

High idle adjustment:

1. With engine running, place the idle switch in the "HIGH IDLE" position. The solenoid should immediately de-energize, allowing the engine to increase to high idle speed.
2. If the high idle RPM requires adjustment, loosen the high idle adjustment screw jam nut and turn the adjusting screw until the engine speed is between 3625 and 3675 RPM. Hold the adjusting screw in position while tightening the jam nut against the solenoid plunger. **See Figure F.6.**
3. Re-check the high idle RPM.
4. Close the engine service access doors and shut off the engine.

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IDLER SOLENOID TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the idler solenoid resistance values are normal, and also determine if it will function normally when it is energized with 12VDC.

MATERIALS NEEDED

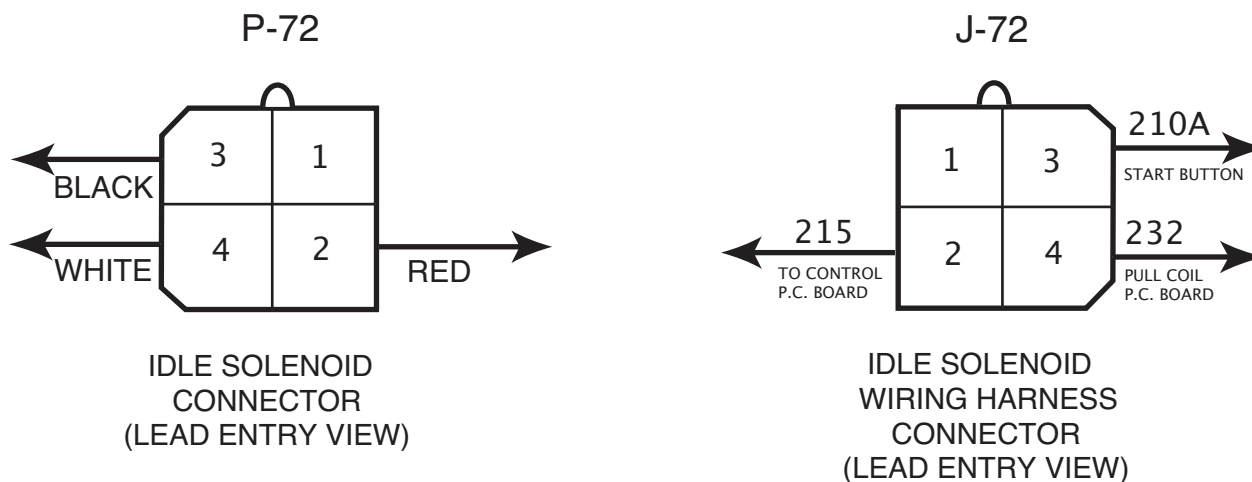
- Miscellaneous hand tools
- External 12VDC supply (30 amps) (automotive battery works well)
- Wiring Diagram
- Volt/Ohmmeter

RANGER 305D



IDLER SOLENOID TEST (*continued*)

FIGURE F.7 – PLUG(S) PIN LOCATION

**TEST PROCEDURE**

1. Turn the engine off.
2. Open the right side engine service access door.
3. Locate the idler solenoid mounted on the fuel injection pump. (See illustration in **Fuel Solenoid Test**)
4. Locate and unplug harness connection P/J 72. Cut any necessary cable ties. See Wiring Diagram.
5. Using the volt/ohmmeter, check the pull-in coil resistance, pins 3 and 4 (black wire to white wire). The normal resistance is less than 0.5 ohms. Check the hold-in coil resistance, pins 3 and 2 (black wire to red wire). The normal resistance is approximately 12 to 15 ohms. Check the resistance between pin 3 (black wire) and a clean, unpainted chassis ground. The resistance should be very high. 500,000 Ohms or more. If any of the above resistance values are incorrect, the solenoid may be faulty. Replace. See Figure F.7.
6. Using the external 12VDC supply, apply 12VDC to the pull-in coil leads at pins 3+ and 4- (black wire to white wire). The solenoid should activate. REMOVE THE VOLTAGE IMMEDIATELY to avoid damage to the unit.
Apply 12VDC to the hold-in coil at pin #3 (black wire +) and pin #2 (red wire -). While the voltage is applied, manually move the solenoid to the low idle position. The solenoid plunger should hold this position until the voltage is removed. See Figure F.7.
7. If either coil does not operate as described, check for mechanical restrictions or other problems with the linkage.
8. If the linkage is intact and the solenoid does not operate correctly when the 12VDC is applied, the solenoid may be faulty. Replace.
9. Re-connect idle solenoid and replace any previously removed cable ties.
10. If finished testing, close the engine service access door.

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ENGINE ALTERNATOR TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

This test will determine if the engine alternator is properly charging the battery.

MATERIALS NEEDED

- Miscellaneous hand tools
- Volt meter
- Wiring Diagram

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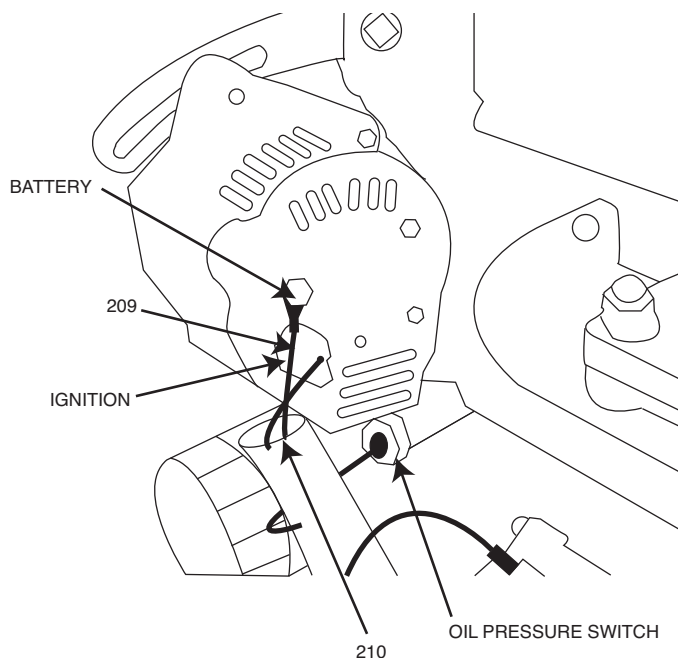


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TROUBLESHOOTING & REPAIR

ENGINE ALTERNATOR TEST (*continued*)

FIGURE F.8 – LEAD LOCATIONS



TEST PROCEDURE

1. Turn the engine off.
2. Open the engine access door and check the voltage at the battery terminals. It should be approximately 12 volts DC.
3. Attach the meter leads to the battery terminals, being careful to position them so they stay clear of moving parts while the engine is running.
4. Place the idle switch in the "HIGH IDLE" position, start the engine, and allow it to run at high idle speed for about 15 to 30 seconds.
5. The meter should read about 13.7 to 14.2 VDC.
6. If the meter reads correctly the engine alternator is producing adequate power to charge the battery and this test is complete.
6. If the voltage is significantly higher than the above values, the alternator is not properly regulating the battery charging voltage and should be replaced. If the voltage reads the same or less than the measurement taken when the engine was not running, proceed with the following tests.
7. Turn off the engine, disconnect the meter from the battery, and open the engine access door on the left side of the machine.
8. Make sure the idle switch is still in the "high" position, start the engine, and allow it to run at high idle speed for about 15 to 30 seconds.
9. Place the negative meter probe on a good chassis ground, or the negative battery terminal. Place the positive meter probe on the battery terminal on the back of the alternator. (Lead #209) See Figure F.8. See Wiring Diagram.
10. The meter should read about 13.7 to 14.2 VDC.
11. Move the positive probe to the IGN terminal on the back of the alternator. (Lead @210C) See Figure F8.
12. The meter should read about 13.7 to 14.2 VDC.
13. If the meter reads correctly, check the connections between the alternator and the battery. See wiring diagram.
14. If the voltage at both of the above test points reads the same or less than the battery voltage measurement taken when the engine was not running, the alternator is defective. Repair or replace it.
15. If battery voltage is present at the battery terminal of the alternator, but not at the "IGN" terminal; check the run/stop switch and the wiring connecting the "IGN" terminal to the switch. See Figure F8.

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BRUSH AND SLIP RING SERVICE PROCEDURE**WARNING**

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

This procedure provides guidance in testing and maintaining the brush and slip ring system.

MATERIALS NEEDED

Volt/Ohmmeter
Miscellaneous hand tools
500 or 600 grit emery cloth
180 grit sand paper

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TROUBLESHOOTING & REPAIR

BRUSH AND SLIP RING SERVICE PROCEDURE (*continued*)

TEST PROCEDURE

1. Perform the **Case Cover Removal Procedure**
2. Examine brushes and slip rings. The slip rings, brush holder, and brushes should be clean and free from oil or grease. The brushes should be making good, continuous contact with the slip rings.
3. The brushes should be of sufficient length and have adequate spring tension. Generally, the brushes should be replaced if either brush has less than 1/4" remaining before it reaches the end of its travel. Spring tension should be sufficient to hold the brushes firmly against the slip rings.
4. The brushes should be removed from the brush holder and examined. The terminals should be clean. The shunt, (braided lead connecting the carbon brush to the terminal) should be in good condition and firmly connected to the carbon brush and to the connection terminal.
5. If the slip rings are discolored, display evidence of excessive sparking, or the brushes have worn prematurely; these may be signs of a grounded or shorted rotor. Perform the **rotor resistance test**.
6. Check for evidence of sticking brushes. Sticking brushes will normally result in the slip rings being pitted and discolored from excessive arcing. Another sign of sticking brushes is instability or loss of both weld and auxiliary output, but the machine may begin to work properly, for a short time, after being jarred or moved.

7. If there is any evidence that the brushes may have been sticking in the brush holders, a new brush holder and brush assembly should be installed..

Cleaning slip rings:

1. In the event that the slip rings have become dirty, discolored or mildly pitted, it will be necessary to clean them, using very fine, 500 or 600 grit emery cloth or a 220 or 320 grit commutator stone.

Seating Brushes:

1. If brushes have been replaced, repositioned, or are not making full contact with the slip rings, it may be necessary to re-seat them. This can be done by placing a strip of 180 grit sandpaper between the slip rings and the brushes, with the abrasive side against the brushes. Pull the sandpaper strip around the circumference of the slip rings in the direction of rotor rotation only. Repeat this procedure until the surface of each brush is in full contact with its matching slip ring.
2. Use a low pressure compressed air to thoroughly blow the carbon, commutator stone, and sandpaper dust from the machine before operating.
3. Perform the **Case Cover Replacement Procedure**.

Note: **See Figure F.9** for general locations.

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ROTOR RESISTANCE AND GROUND TEST (STATIC)

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the rotor winding is open, shorted, or grounded.

MATERIALS NEEDED

- Miscellaneous hand tools
- Ohmmeter Analog type meter required for dynamic resistance test.)
- Wiring Diagram

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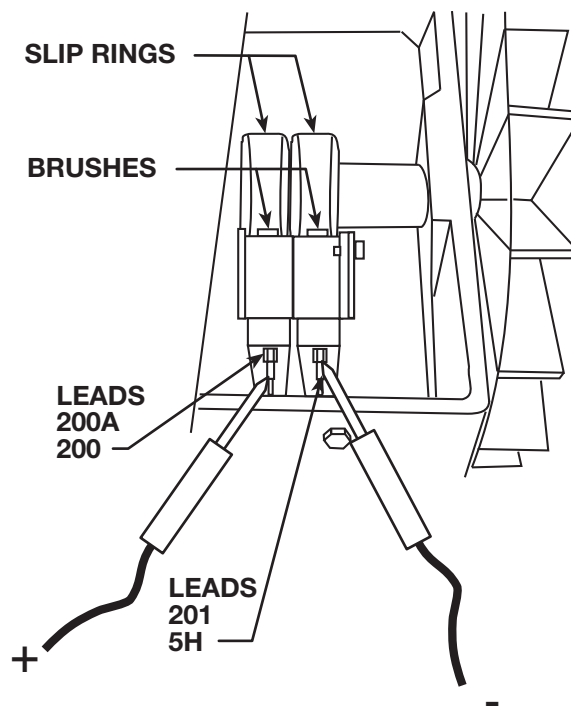


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TROUBLESHOOTING & REPAIR

ROTOR RESISTANCE AND GROUND TEST (STATIC) *(continued)*

FIGURE F.9 – ROTOR BRUSH LEADS



TEST PROCEDURE

1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure.
3. Locate and label the four leads from the rotor brush holder assembly. See Figure F.8. Using the needle nose pliers, remove the leads. This will electrically isolate the rotor windings.
4. Using the ohmmeter, check the rotor winding resistance across the slip rings. See Figure F.9. Normal resistance is approximately 4.7 *ohms, at 77 degrees Fahrenheit. (25degreesC.).
5. Measure the resistance to ground. Place one meter probe on either of the slip rings. Place the other probe on any good unpainted chasms ground. The resistance should be very high, at least 500,000 (500k) ohms.
6. If the test does not meet the resistance specifications, then the rotor may be faulty and should be replaced.
7. If this test meets the resistance specifications, continue testing using the dynamic rotor resistance and ground test.

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ROTOR RESISTANCE AND GROUND TEST (DYNAMIC)

(Also referred to as flying resistance test)

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test checks for faults in the rotor winding, while these windings are being stressed by the mechanical forces encountered during normal operation.

MATERIALS NEEDED

- Miscellaneous hand tools
- Ohmmeter Analog type meter required for dynamic resistance test.)
- Wiring Diagram

Note: This test is best performed with a good quality analog type ohmmeter. Many digital meters will not provide stable or accurate Resistance readings while the rotor is spinning.

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TROUBLESHOOTING & REPAIR

ROTOR RESISTANCE AND GROUND TEST (DYNAMIC) *(continued)*

TEST PROCEDURE

This test requires that the brushes and slip rings are clean, in good condition, and are properly seated.

1. Perform the ***brush and slip ring service procedure*** if necessary.
2. Insulate the lead wires that had been disconnected from the brushes during the static rotor resistance test. Position and secure them so they cannot become damaged by the spinning rotor.
3. Securely attach the ohmmeter leads to the brush terminals. Use clips or terminals to attach the leads **BEFORE** starting the engine.
4. Start the engine and run it at high idle speed (3650 RPM). The resistance should read approximately 5* ohms at 77 degrees Fahrenheit (25 deg. C.)
4. Shut off engine, and move one of the ohmmeter leads to a good clean chassis ground.
5. Restart the engine and run it at high idle speed (3650 RPM). The resistance should be very high, at least 500,000 (500k) ohms.
6. If the resistance readings differ significantly from the values indicated, re-check the brushes and the brush spring tension. If the brushes and slip rings are good, replace the rotor.
7. If all testing is finished, perform the ***Case Cover Replacement*** procedure.

*NOTE: The resistance of the windings will change with temperature. Higher temperatures will produce higher resistance, and lower temperatures will produce lower resistance.

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TROUBLESHOOTING & REPAIR

ROTOR VOLTAGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the rotor winding is operating at normal charge.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Wiring Diagram

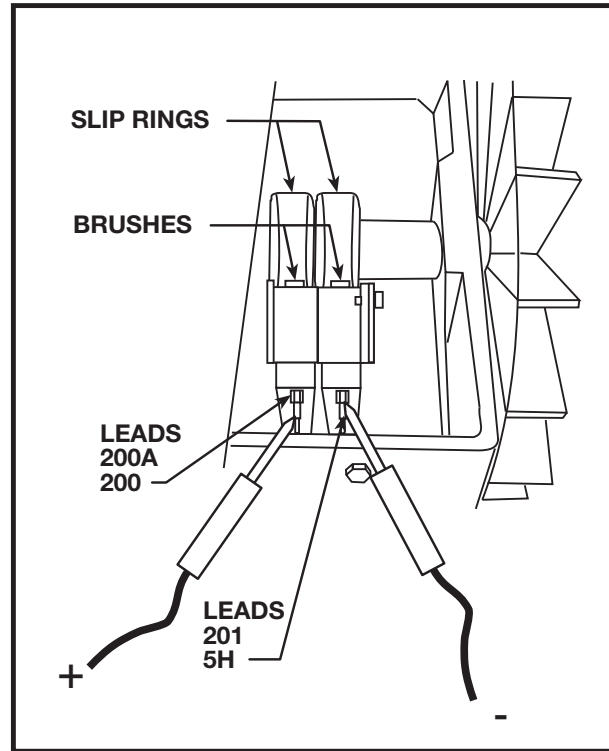
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TROUBLESHOOTING & REPAIR

ROTOR VOLTAGE TEST *(continued)*

FIGURE F.10 – LEAD LOCATIONS



TEST PROCEDURE

1. Perform the **Case Cover Removal** procedure.
2. Connect the voltmeter probes to the brush terminals. See Figure F.10. See the wiring diagram.
3. Set the RUN/STOP switch to "RUN" and the IDLE switch to "HIGH". Start the engine and allow the RPM to stabilize for about 15 to 30 seconds.
The meter should read 46 to 54 VDC.
4. Set the RUN/STOP switch to "STOP"
5. If the meter reading is normal, this test is complete.
6. If the voltage measures zero or very near zero, the rotor flashing circuit may be faulty or the rotor may be shorted.
7. Perform the **Rotor Resistance and Ground Test** and the **Rotor Flashing Voltage Test**.
8. **If voltage is higher than 54 VDC**, the engine RPM may be too high, or there may be voltage intrusion from one of the higher voltage stator windings to the stator exciter winding. Perform the **Engine Throttle Adjustment Test**, and the **Stator Short Circuit and Ground Test**.
9. **If the voltage is lower than 46, but higher than 14**, the engine RPM may be too low, or there may be problems in the windings or other exciter circuit components or connections. Perform the **Engine Throttle Adjustment Test**, and then perform the testing described below, under the heading **"If the voltage measures about 3 to 5 VDC"**

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TROUBLESHOOTING & REPAIR

ROTOR VOLTAGE TEST (*continued*)

10. If the meter reading indicates battery voltage, about 12 to 14 VDC, the rotor may be open, or the brushes may be faulty or not making proper contact with the slip rings. Perform the ***Rotor Resistance Test***, and ***Brush and Slip Ring Service Procedure***.
11. If the voltage measures about 3 to 5 VDC, the generator is not building-up to normal output even though the flashing circuit appears to be functioning normally. This condition could be caused by one of several failed components or connections. Continue with the following test.
12. Check the field bridge rectifier, (D3) and capacitor (C3); also check the wiring and terminals connecting them. See the wiring diagram.
13. Perform the ***Rotor Resistance Test***.
14. Perform the ***Stator Short Circuit and Ground Test***.
15. When the Stator short circuit and ground test has been completed, reconnect leads #7 and #9 to the field bridge rectifier, (D3). All other stator leads should remain disconnected and isolated at this time.
16. Be sure that there are no leads of any kind across any of the stator windings, except the #7 - #9 winding. Examine stator wiring for damage, pinched leads, chafed insulation, etc. If necessary, disconnect and isolate the stator output leads as close to the starter as possible. See wiring diagram.
17. All of these disconnected leads should be insulated, and/or positioned so they cannot come in contact with any other wiring or chassis ground and cannot be damaged by moving parts when the engine is running.
18. Re-start the machine and measure the rotor voltage.
19. If rotor voltage continues to read significantly lower than 50 VDC, the Stator is probably defective and should be replaced.

Note: The field bridge rectifier and field capacitor may appear to function normally when tested independently, but may malfunction when placed under the stress or normal operation. For this reason, It is recommended that the bridge rectifier and the capacitor be replaced with known good components before replacing the stator.

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TROUBLESHOOTING & REPAIR

FLASHING VOLTAGE TEST (Engine Not Running)

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-93-3877.

DESCRIPTION

This test checks the flashing voltage with the engine stopped, by simulating a running condition.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Wiring Diagram

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TROUBLESHOOTING & REPAIR

FLASHING VOLTAGE TEST (*continued*)

TEST PROCEDURE

1. Perform the **Case Cover Removal Procedure**.
2. Make sure that the battery is fully charged and in good condition, and the battery connections are clean and tight.
3. Remove lead #229 from the oil pressure switch; see wiring diagram and Figure #1. Insulate or position the lead so it cannot come in contact with chassis ground or any other wiring. See Figure F.11.

NOTE: Disconnecting lead #229 bypass the oil-pressure switch and simulates a running engine.

NOTE: The oil pressure switch is located on the left side of engine just above the oil filter. See Figure #1.

4. Place the RUN/STOP switch in the "RUN" position. (The engine protection light should remain off.)
5. **Connect the voltmeter probes to brush terminals. See wiring diagram and figure #2.**
6. Measure the voltage; it should read about 3 to 5 VDC.
7. Set the RUN/STOP switch to the "STOP" position.
8. **If the meter reads normal voltage of 3 to 5 VDC, this test is complete.**
9. If the meter reading indicates battery voltage, about 12 to 14 VDC, The rotor may be open, or the brushes may be faulty or not making proper contact with the slip rings.
10. Perform the **Rotor Resistance Test. Perform the Brush and Slip Ring Service Procedure.**

11. If the voltage measures zero or very near zero; this condition could be caused by a poor connection or a defective component in the flashing circuit, or a shorted rotor winding.

12. Perform the **Rotor Resistance Test.**

11. Refer to the wiring diagram, pull plug P-2 from the control PC board and inspect each terminal. Make sure that all terminals both on the board and in the plug are clean and in good condition, and that the pins are securely crimped to the flex leads. Perform the following additional test.

13. Switch the RUN/STOP switch to the "RUN" position.

14. Use a voltmeter to check for the presents of about 12VDC, battery voltage, at the following locations on the control PC board.

(-) Lead #5K (P2-3) to (+) Lead #210H (P2-7)

(-) Lead #5K (P2-3) to (+) Lead #224B (P2-9)

(-) Lead #5K (P2-3) to (+) Lead #200N (P2-1)

NOTE: Lead #210H supplies 12VDC battery voltage to the control PC board whenever the run/stop switch is in the run position.

Lead #200N supplies DC flashing voltage from the control PC board to the positive slip ring through the R3 resistor.

15. **If battery voltage is preset at all of the above points; check the top grounding stud on inside left case from and lead #5H, also check leads #200, #200N, and the 25 Ohms flashing resistor, R3. Make sure all terminals are crimped tightly to the flex leads and arc free of corrosion.**

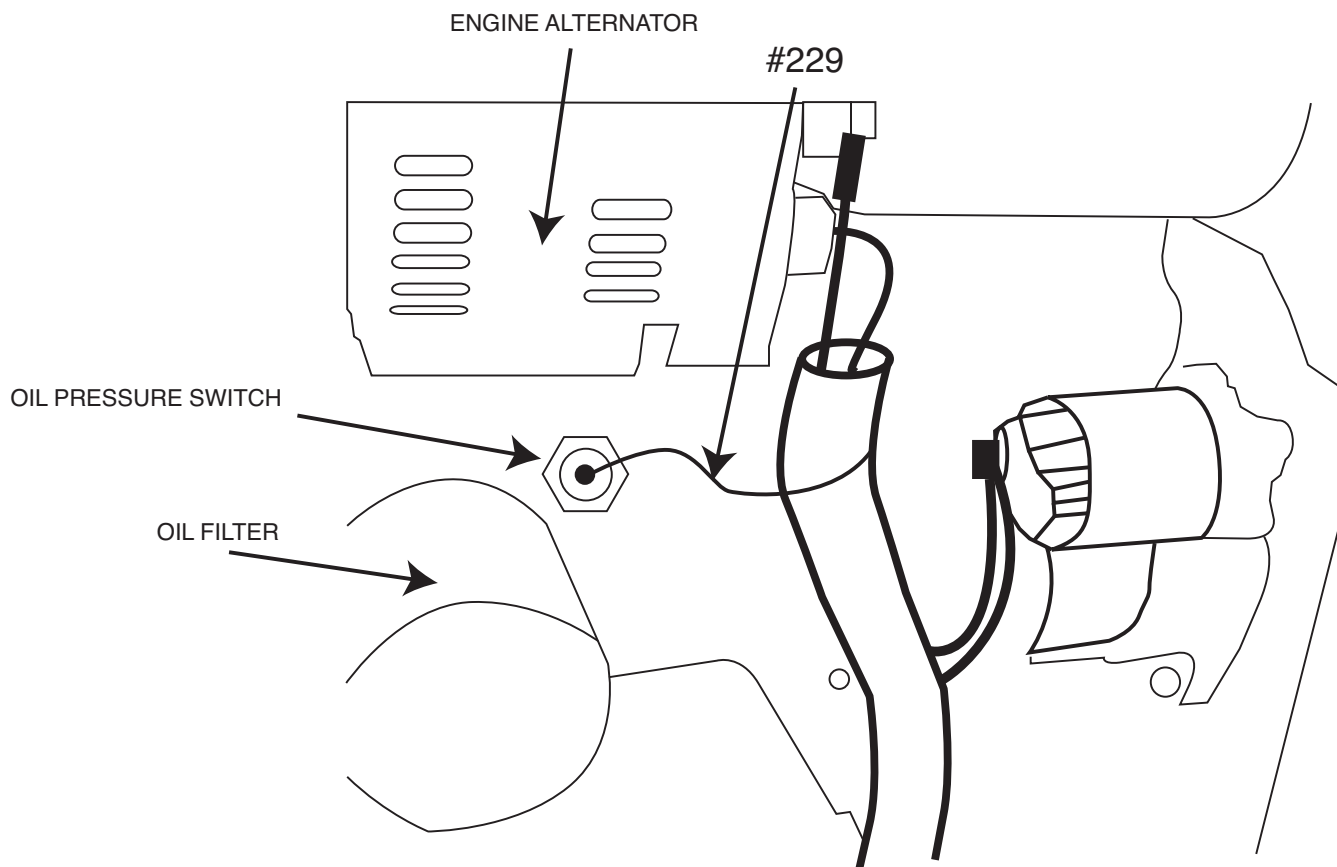
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TROUBLESHOOTING & REPAIR

FLASHING VOLTAGE TEST (continued)

FIGURE F.11 – EXCITER LEADS T1, T2, T3



16. If battery voltage is present at leads #210H and #224B, but not present at leads #200N The Control PC board is probably defective. Replace.
17. If battery voltage is present at lead #210H, but not present at leads #224B or #200N check the engine protection wiring and CR1 engine protection relay, per the wiring diagram. Also check that the oil pressure switch lead, (lead #229) has not come into contact with chassis ground. *The engine protection light should be off during this test.*
18. If battery voltage is not present at lead #210H, check wiring per wiring diagram, and check the run/stop switch. Also check the ground PC board chassis ground wire, lead #5K and the stud where it connects to the chassis.
19. Set the RUN/STOP switch to the “STOP” position.
20. Re-connect lead #229 to the oil pressure switch.
21. If testing is completed, perform the **Case Cover Replacement** procedure.

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STATOR VOLTAGE TESTS

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the stator is able to produce correct voltage from of its windings. It will only yield meaning data if the engine high idle speed is correct, (3625 to 3675 RPM), and approximately 46 to 54 VDC is present across the rotor slip rings.

NOTE: The slip ring voltage will most likely be correct if at least one of the AC output voltages is correct.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Test pins

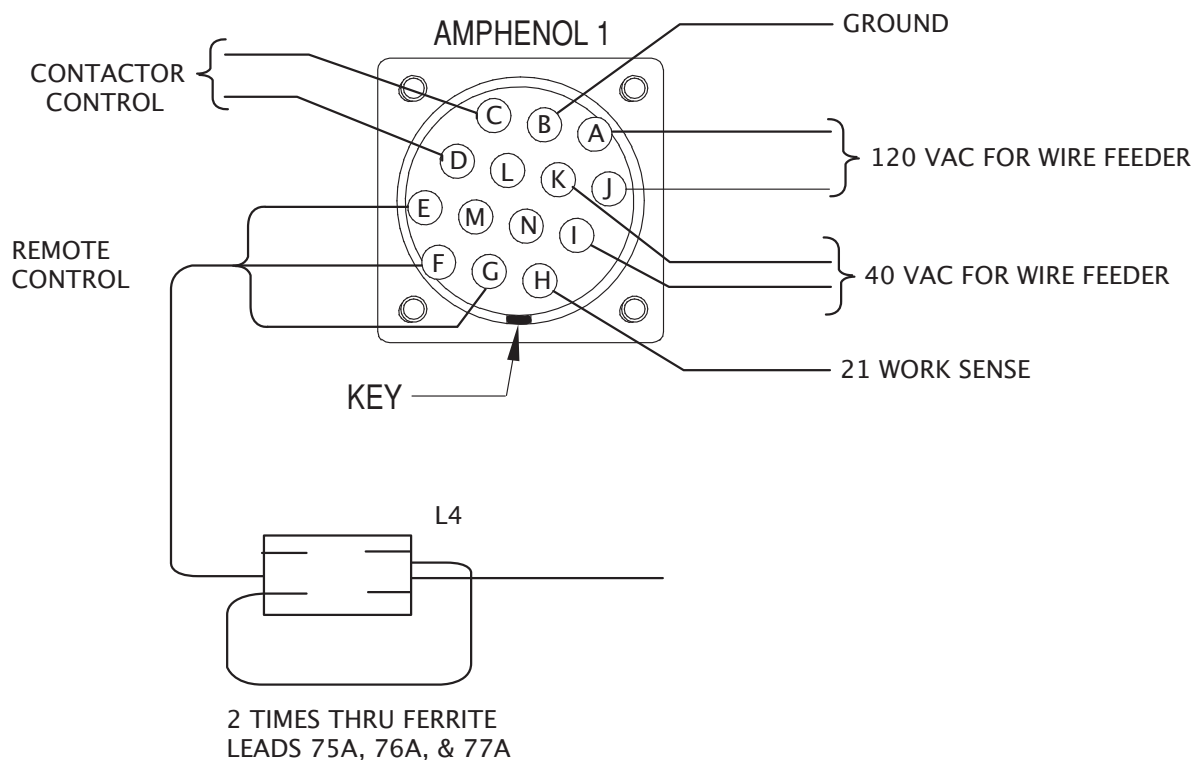
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TROUBLESHOOTING & REPAIR

STATOR VOLTAGE TESTS (continued)

FIGURE F.12 – RECEPTACLE LEAD LOCATIONS (TYPICAL)



TEST PROCEDURE

1. Perform the **Case Cover Removal** procedure.

NOTE: Voltage tests of the 120 and 120/240 VAC receptacles can be performed by placing the meter probes directly into the appropriate connection slots in the front of the receptacles rather than testing at the lead connections described below. If the meter probes are not long enough to make contact with the conductors inside the receptacles, test pins may be used.

To test the 120 VAC auxiliary winding:

1. Connect the volt/ohmmeter probes to either 120 VAC receptacle as follows.
2. For the upper receptacle, place the probes directly into receptacle, or connect to leads #3D and #5A. See Figure F.12. See wiring diagram.

For the lower receptacle, place the probes directly into the receptacle, or connect to leads #6E and 5B. See Figure F.12. See wiring diagram.

3. Start the engine and run it at high idle (3650 RPM).
4. Check the AC voltage reading. It should read between 120 and 135* VAC.

To test the 240 VAC auxiliary winding:

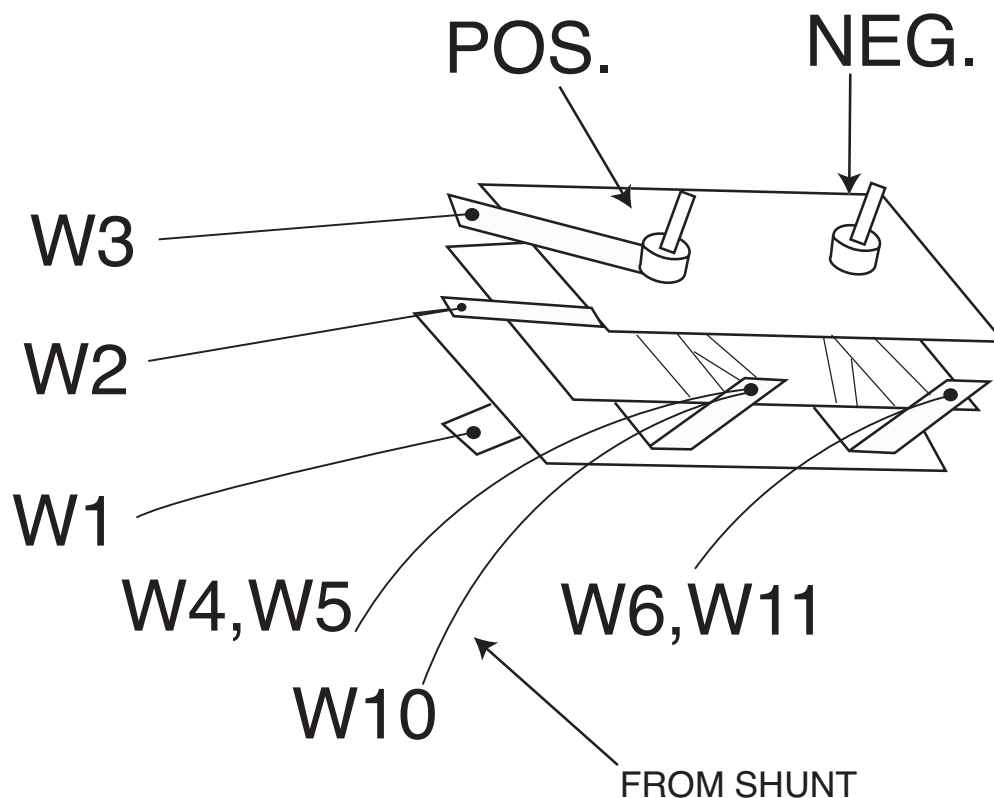
1. Connect the meter probes to leads #6F and #3E where they connect to the 120/240VAC receptacle, or insert the probes into the 240 VAC connection slots in the front of the receptacle. See Figure F.12. See wiring diagram.
2. Start the engine and run it at high idle (3650 RPM).
3. Check the AC voltage reading. It should read between 236 and 252 VAC.
4. If these voltage readings are not within the specified limits, check for tripped or defective circuit breakers, loose connections, or broken wires between the test points and the stator windings. If there are no wiring problems, and the circuit breakers are not tripped or defective, the stator is defective and should be replaced.

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STATOR VOLTAGE TESTS *(continued)*

FIGURE F.13 – RECTIFIER BRIDGE DETAIL

**To test the 120 VAC wire feeder supply:**

NOTE: The wire feeder AC voltage supply tests require that the meter probes be inserted into the Amphenol connection cavities. Care should be taken to avoid damaging or expanding the terminals when inserting the probes.

NOTE: The 120 VAC power supplied to the 14 pin Amphenol connector originates from the same winding that supplies the 120 VAC receptacles. If the machine has previously passed 120VAC auxiliary winding test, this test can only reveal problems in connections or components between the Amphenol and the stator winding.

1. Connect the voltmeter probes to pins "A" (lead #32) and "J" (lead #31) of the 14 pin Amphenol. See figure #3 and wiring diagram.
2. Start the engine and run it at high idle (3625 to 3675 RPM).
3. The AC voltage reading should be between 120 and 135* VAC.
4. If these voltage readings are not within specifications, check for a tripped or defective circuit breaker, faulty connections, or broken wires between the test points and the stator windings. See wiring diagram.

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STATOR VOLTAGE TESTS *(continued)*

To test the 42 VAC wire feeder winding:

1. Connect the voltmeter probes to pins "I" (lead 41A) and "K" (lead #42A) of the 14 pin Amphenol. **See Figure F.12.**
2. Start the engine and run it at high idle (3625 to 3675 RPM).
3. The AC voltage reading should be between 40 and 50 VAC.
4. If these voltage readings are not within the specified limits, check for a tripped or defective circuit breakers, loose connections, or broken wires between the test points and the stator windings. If there are no wiring problems, and the circuit breakers are not tripped or defective, the stator is defective and should be replaced.

To test the three-phase weld winding:

1. Locate weld winding leads W1, W2, and W3 where they connect to the three-phase output bridge rectifier. See Figure F.13. See wiring diagram.
2. Start the engine and run it at high idle (3625 to 3675 RPM).
3. Check for about 60 to 65 VAC from leads W1 to W2, W2 to W3, and W1 to W3.
4. If these voltage readings are not within the specified limits, check for loose connections or broken wires between the test points and the stator windings. If there are no wiring problems, the stator is defective and should be replaced.

* These values are maximum for a cold machine.

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TROUBLESHOOTING & REPAIR

STATOR SHORT CIRCUIT & GROUND TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if there are undesirable electrical connections between the stator windings and chassis ground, or between individual windings within the stator.

This test should be performed if flashing voltage is present at the rotor slip rings, Rotor resistance, field bridge rectifier, field capacitor and all associated wiring are proven to be good, but the stator output voltage fails to build-up to normal levels, or is too high in one or more, but not all, of the windings.

MATERIALS NEEDED

Miscellaneous hand tools
Ohm meter

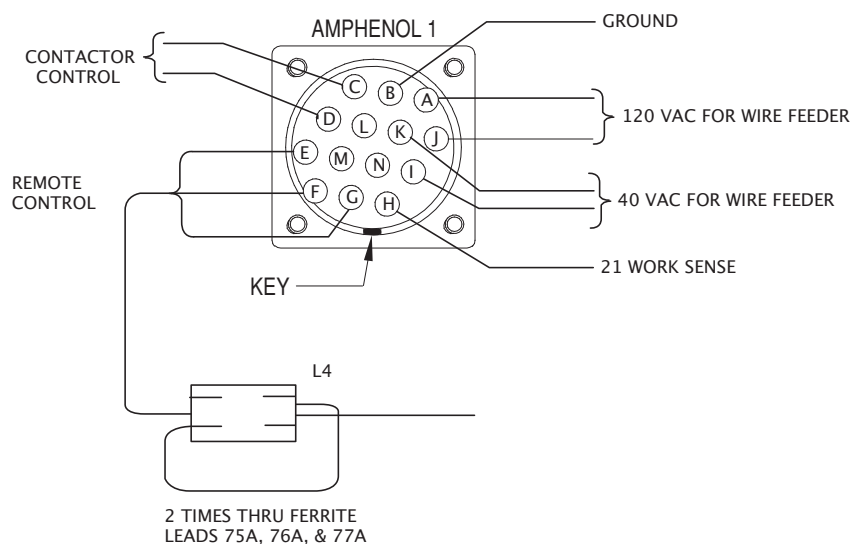
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STATOR SHORT CIRCUIT & GROUND TEST *(continued)*

FIGURE F.14 – WELD CONTROL BOARD



TEST PROCEDURE

1. Perform **Case Cover Removal Procedure**.
2. Perform **Capacitor Discharge Procedure**.
3. Unplug anything that may be connected to the auxiliary receptacles or the 14 pin amphenol.
4. Disconnect and isolate GND-E lead from the bottom ground screw inside the left case front. See control Inner-Connection diagram. See Figure F.14.
5. Disconnect the #7 and #9 leads from the field bridge rectifier. See Wiring Diagram.
6. Using an ohmmeter, check the resistance between chassis ground and each of the following points; Resistance should read very high, 500,000 (500K) ohms minimum.
 - 1) Pin 1 at the 14 pin amphenol, and the #5 lead that had been disconnected from the ground screw. (this checks for a connection between the wire feed winding and the auxiliary winding.)
 - 2) Pin 1 of the 14 pin amphenol and lead #7 or #9. (This checks for a connection between the wire feed winding and the exciter winding.)
 - 3) Pin 1 of the 14 pin amphenol an lead W1, W2, or W3. (This checks for a connection between the wire feed winding and the weld winding).
 - 4) Lead #5 and lead #7 or #9. (This checks for a connection between the auxiliary winding and the weld winding). See Wiring Diagram.
 - 5) Lead #5 and lead W1, W2, or W3. (This checks for a connection the auxiliary winding and the weld winding.) See Wiring Diagram.
 - 6) Lead #7 or #9 and lead W1, W2, or W3. (This checks for a connection between the exciter winding and the weld winding.) See Wiring Diagram.

If any of the above readings is less than 500,000 (500k) ohms, check for damaged, contaminated, or shorted wiring or components between the test points and the stator winding. If necessary, disconnect and isolate the stator leads as close to the stator winding as possible. See wiring diagram. If the low resistance is determined to be between the windings within the stator, the stator is defective and should be replaced*.

* NOTE: *The field bridge rectifier and field capacitor may appear to function normally when tested independently. But may malfunction when placed under the stress of normal operation. For this reason, It is recommended that the bridge rectifier and capacitor be replaced with known good components before replacing the stator.*

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OUTPUT RECTIFIER BRIDGE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the rectifier is grounded, or if there are any failed diode groups.

NOTE: This test will not be able to detect individual open diodes within a group.

MATERIALS NEEDED

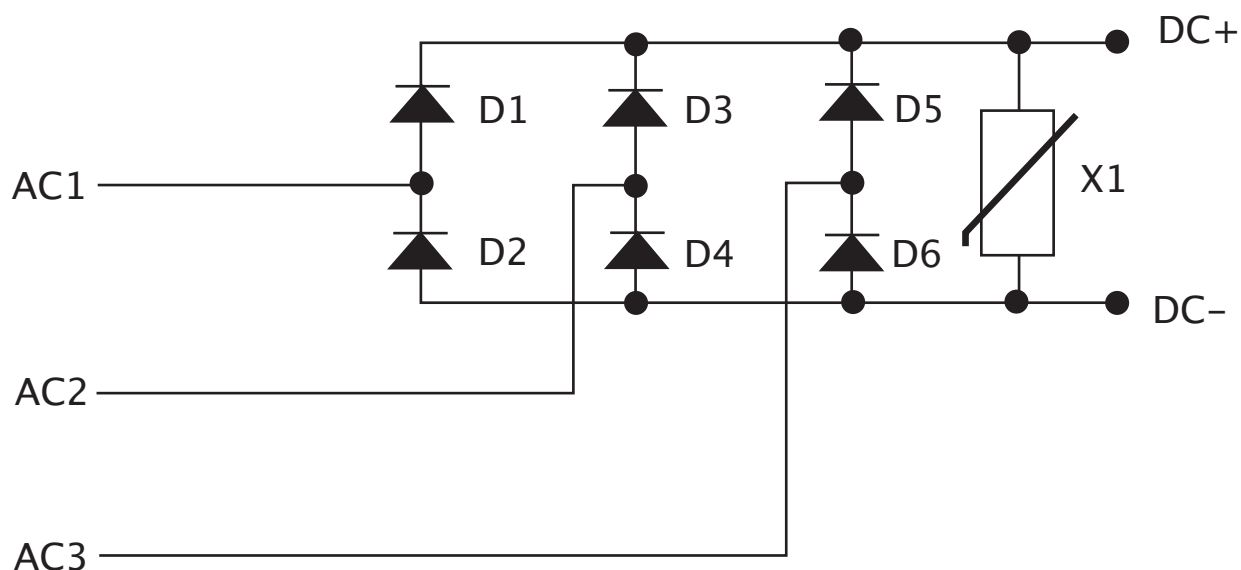
- Miscellaneous hand tools
- Analog Ohmmeter or diode tester (For testing diodes)
- Ohm meter (any type for ground test)

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OUTPUT RECTIFIER BRIDGE TEST (*continued*)

FIGURE F.15

**TEST PROCEDURE**

1. Turn the engine off.
2. Perform the **Case Cover Removal** procedure.
3. Perform the **Chopper Module Capacitor Discharge** procedure.

Electrically isolate the three-phase input terminals of the output bridge rectifier as follows:

4. Mark leads W1, W2, and W3 so they can be properly reconnected after the test is complete. Remove these leads and position them so they do not come in contact with any part of the rectifier. **See figure F16.** See wiring diagram.

Electrically isolate the DC output terminals of the rectifier:

5. Mark the leads connected to the positive and negative terminals of the output bridge rectifier to assure that they can be reconnected properly. **See figure F-16.**
6. Remove leads W4, W5, and W10 from the positive terminal of the Rectifier, and remove leads W6 and W11 from the negative terminal. Position these leads so they do not come into contact with any part of the rectifier. **See Figure F.16.** See the wiring diagram..

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OUTPUT RECTIFIER BRIDGE TEST (continued)

7. Check for grounds by placing one of the ohm meter probes on a clean, unpainted metal surface of the machine. Touch the other probe to each of the five rectifier terminals. The resistance to chassis ground from each terminal should be very high, 500,000 (500K) ohms minimum. If the resistance reading is less than specified, the rectifier is grounded and should be replaced.
8. If using diode checker or a multimeter with diode check functionality, read and understand the instructions that accompany your test equipment.
9. If using an analog ohmmeter, the forward bias test will indicate low resistance and the reverse bias test will indicate high resistance. Precise ohm values for this test will vary depending on a test equipment used.

NOTE: A digital Ohmmeter is not recommended for this test. A typical digital Ohmmeter does not provide enough voltage or current flow to reliably test the diodes used in this rectifier.

10. Test all of the diode groups per the **Table F.1**.

FIGURE F.16 – SHUNT/RECTIFIER LEADS

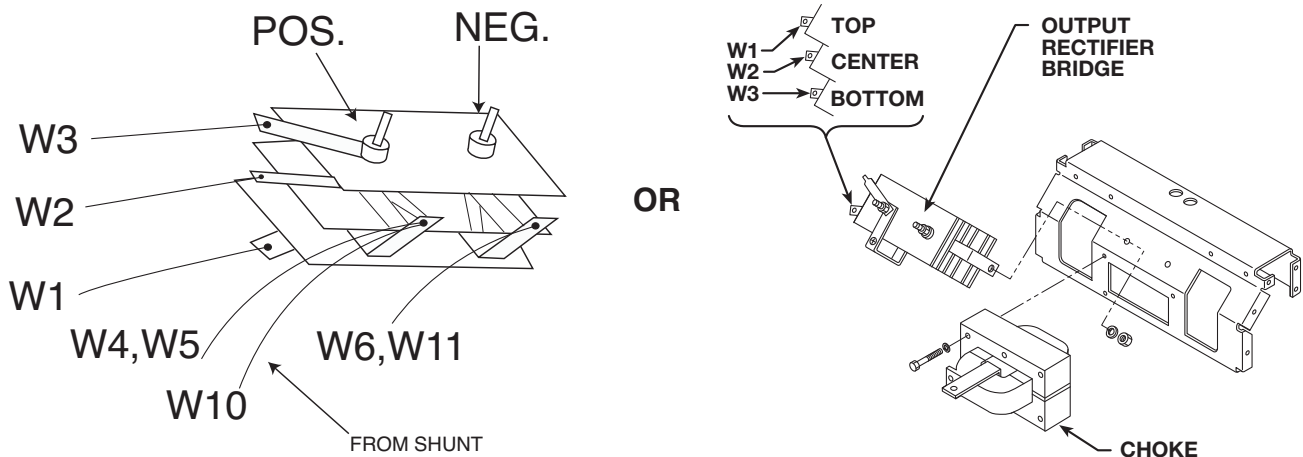


TABLE F.1 – DIODE TEST TABLE

	Test Instrument		Diode Bias and Expected Test Result
	(+) Lead	(-) Lead	
Rectifier Terminal Connections	AC1	DC(+)	FORWARD BIAS (Low Resistance)
	AC2	DC(+)	FORWARD BIAS (Low Resistance)
	AC3	DC(+)	FORWARD BIAS (Low Resistance)
	DC(-)	AC1	FORWARD BIAS (Low Resistance)
	DC(-)	AC2	FORWARD BIAS (Low Resistance)
	DC(-)	AC3	FORWARD BIAS (Low Resistance)
	AC1	DC(-)	REVERSE BIAS (High Resistance)
	AC2	DC(-)	REVERSE BIAS (High Resistance)
	AC3	DC(-)	REVERSE BIAS (High Resistance)
	DC(+)	AC1	REVERSE BIAS (High Resistance)
	DC(+)	AC2	REVERSE BIAS (High Resistance)
	DC(+)	AC3	REVERSE BIAS (High Resistance)

11. Reconnect all leads.

12. Perform the **Case Cover replacement Procedure**.

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TROUBLESHOOTING & REPAIR

CHOPPER MODULE FUNCTION TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will help determine if the chopper module is functioning properly, and receiving the correct input from the output rectifier and control PC board.

This test can only provide meaningful results if the machine is producing normal AC auxiliary output.

MATERIALS NEEDED

- Miscellaneous hand tools
- Digital Multi-meter
- Frequency counter or digital multi-meter with frequency counter function.
- Wiring diagram
- Control Inner-Connection diagram

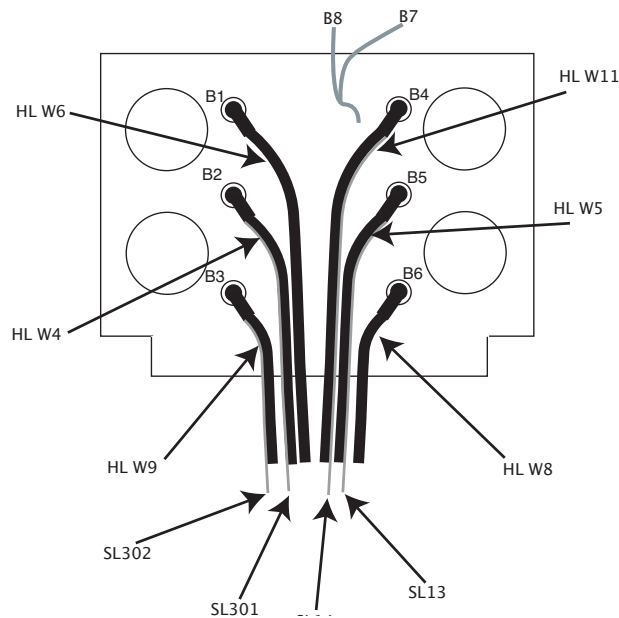
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TROUBLESHOOTING & REPAIR

CHOPPER MODULE FUNCTION TEST (continued)

FIGURE F.17 – POWER MODULE CONNECTIONS



TEST PROCEDURE

1. Perform the **Case Cover Removal Procedure**.
2. Make sure that there is nothing plugged into either of the Amphenol receptacles.
3. Place idle switch in the "HIGH" position.
4. Place the mode switch in the "CC-STICK" position.
5. Place the Welding Terminal switch in the "REMOTELY CONTROLLED" position.
6. Start the engine and allow it to stabilize at high idle RPM.
7. Check for 80 to 100 VDC at terminals B1- to B2+ and B4- to B5+ of the chopper module. See wiring diagram and figure #1.
8. If the correct DC voltage is not present at terminals B1- to B2+ and B4- to B5+, check for damaged conductors or faulty connections between the chopper module, the output rectifier, and the stator weld winding. See Figure F.17. See the wiring diagram. Perform the **Stator Voltage Tests**, and the **Output Rectifier Test**.
9. If the correct voltage is present at terminals B1- to B2+ and B4- to B5+ of the chopper module, check for DC voltage at the chopper module terminals B2+ to B3-, and B5+ to B6-. If significant voltage is present, disconnect leads #23 and #25 from the chopper module PC board. If voltage is still present, the copper module is shorted and should be replaced.
10. If the voltage drops to 0 VDC after the #23 and #25 leads have been disconnected, the control PC board is driving the chopper module when it should not be doing so. Reconnect the #23 and #25 leads and perform the **Weld Control Board Gate Drive Test**.
11. Reconnect leads #23 and #25, and place the Welding Terminal switch in the "WELD TERMINALS ON" position.
12. Check for about 58 VDC between Chopper Module Terminals B2+ to B3-, and B5+ to B6 and between the welder output terminals. See Figure F.17. See the wiring diagram.

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TROUBLESHOOTING & REPAIR

CHOPPER MODULE FUNCTION TEST *(continued)*

TEST PROCEDURE (CONTINUED)

13. If about 58 VDC is present at chopper module terminals B2+ to B3-, and B5+ to B6-, but not at the output terminals, there is a problem between the chopper module and one of the output terminals. Check for damaged conductors or faulty connections, on leads W7, W8, W9, and W10. Also check the shunt, the choke, and the connections at the back of the output terminals. See the wiring diagram.
14. If the voltage at terminals B2+ to B3-, and B5+ to B6- of the Chopper module is significantly higher than 58 VDC, check for an open R4 load resistor. See the Control Inner-Connection diagram. Also check for damaged conductors or faulty connections at leads #302 and #302. See wiring diagram.
15. If the voltage at terminals B2+ to B3-, and B5+ to B6- of the chopper module is very low, or not present, use the frequency counter to check for the presents of a 20 kHz PWM signal between leads #23 +and #25-, where they connect to the chopper module PC board.
16. If the 20 kHz signal is present, the chopper module is defective. Replace.
17. If the 20 kHz signal is not present, perform the **Weld Control Board PWM Gate Drive Test**.
18. If the weld control board is producing a PWM gate signal, check th e#23 and #25 leads for damaged conductors and faulty connections between the control PC board and the chopper module.
19. If testing is complete, Perform the **Case Cover Replacement** procedure.

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TROUBLESHOOTING & REPAIR

CHOPPER MODULE RESISTANCE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will help determine if the chopper module is shorted. This test can only detect some problems in the “Power” section of the module. Problems in some other PC board components may not be detected.

MATERIALS NEEDED

- Miscellaneous hand tools
- Digital Ohmmeter
- Wiring diagram

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TROUBLESHOOTING & REPAIR

CHOPPER MODULE RESISTANCE TEST *(continued)*

TEST PROCEDURE

1. Perform the **Case Cover Removal Procedure**.
2. Perform the **Capacitor Discharge Procedure**.
3. Check that all of the leads connected to the chopper module terminals are clearly marked to facilitate reassembly. Remove all of the leads from the chopper module and position them so they do not make electrical contact with any part of the module. See the wiring diagram.
4. Use a digital Ohmmeter to test the module per **Table F.2**.

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TROUBLESHOOTING & REPAIR

CHOPPER MODULE RESISTANCE TEST *(continued)*

TABLE F.2 – DIODE TEST TABLE

Chopper Terminal Connections	OHMMETER		OHMMETER READING
	(+) Lead	(-) Lead	Diode Bias and Expected Test Result
	B5	B6	6K to 9K
	B6	B5	6K to 9K
	B4	B5	200k or higher
	B5	B4	400k or higher
	B4	B6	200k or higher
	B6	B4	400k or higher
	B2	B3	6K to 9K
	B3	B2	6K to 9K
B4	B2	200k or higher	
B2	B4	400k or higher	
B4	B3	200k or higher	
B3	B4	400k or higher	

- Reconnect all leads.
- The chopper module screw connection should be lightened to 50-60 inch-pounds.
- Perform the **Case Cover Replacement procedure**.

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WELD CONTROL BOARD PWM GATE SIGNAL TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will determine if the weld control PC board is able to produce the PWM (Pulse Width Modulated) gate signal needed to control the IGBTs (Insulated Gate Bipolar Transistor) on the chopper module. This test will also verify that the control PC board can turn the PWM gate signal on and off properly.

MATERIALS NEEDED

- Digital Multi-meter
- Frequency counter, or digital Multi-meter with frequency counter function
- Wiring Diagram
- Control Inner-Connection diagram

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WELD CONTROL BOARD PWM GATE SIGNAL TEST (*continued*)

TEST PROCEDURE

1. Perform the **Case Cover Removal Procedure**.
2. Unplug any device that may be attached to either the 6 pin or the 14 pin Amphenol receptacles.
3. Place the idle switch in the "HIGH IDLE" position.
4. Place the mode switch in the "CC-STICK" position.
5. Place the Weld terminals switch in the "WELD TERMINALS ON" position.
6. Start the engine and let it run and stabilize at high idle RPM.
7. Locate plug P3 on the control PC board. See Control Inner-Connection diagram.
8. Use the frequency counter to test for 20kHz PWM gate signal between leads #23+ (P3-10) and #25- (P3-9).
9. If the 20KHz gate signal is present, place the weld terminals switch in the "REMOTELY CONTROLLED" position. The gate signal should turn off.
10. If the 20 KHz gate signal responds as described above, this test is complete.
11. If there is no 20 KHz gate signal, test for the presents of 80 to 100 VDC, at leads 13+ (P3-8) to 14- (P3-16) of the weld control PC board.
12. If voltage is very low or not present, check leads #13 and #14 for faulty or damaged wiring or connections between the control PC board and the chopper module.
13. Test for 80 to 100 VDC at the terminals where the #13 and #14 leads connect to the chopper module. See the wiring diagram. If there is no voltage at the chopper module, perform the chopper module function test.
14. If the 80 to 100 VDC supply voltage is present at the weld control PC board, but there is no PWM gate signal, check the voltage between leads #2+ (P1-4) and #4 (P1-3). See figure #1

The voltage should be about 0 VDC.
15. If about 5 VDC is detected, the welding terminal control circuit is open. Check for damaged leads for faulty connections at leads #2 and #4; also check for a defective welding terminal switch. See the wiring diagram.
16. If the PWM signal remains after the welding terminal switch has been placed in the "REMOTELY CONTROLLED" position, check the voltage between leads #2+ (P1-4) and #4- (P1-3) at the control PC board.
17. If the voltage reads 0 or very near 0, Check for damaged insulation at leads #2 and #4, also check for a shorted welding terminal switch, or damaged or contaminated Amphenol receptacle. See the wiring diagram.
18. If the above wiring and components are undamaged and functioning properly, the control PC board is defective and should be replaced.
19. If the voltage reads about 5 VDC, and the PWM signal remains, the control PC board is defective and should be replaced.
20. Perform the **Case Cover Replacement Procedure**.

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WELD CONTROL FEEDBACK TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will determine if the weld control PC board is receiving accurate current and voltage feedback from the weld circuit.

This test will only yield usable information if the machine is producing some weld output.

MATERIALS NEEDED

- Digital Multi-meter suitable for accurate readings in both the millivolt and normal weld voltage ranges.
- Resistive load bank
- Ammeter, suitable for accurate readings of normal welding current. (Often built into the load bank.
- Wiring diagram
- Control Inner-Connection diagram

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TROUBLESHOOTING & REPAIR

WELD CONTROL FEEDBACK TEST (*continued*)

TEST PROCEDURE

1. Place the idle switch in the "HIGH IDLE" position.
2. Place the mode switch in the "CC-STICK" position.
3. Place the weld terminals switch in the "WELD TERMINALS ON" position.
4. Make sure that nothing is plugged into either Amphenol receptacle.
5. Connect the resistive load bank and the ammeter to the weld output terminals per the equipment manufacturer's instructions; also connect the voltmeter probes across the weld output terminals.
6. Start the machine and, apply a load of about 200 Amps, as shown on the external ammeter. If the machine will not produce 200 amps, apply as much load as you can.
7. Compare the readings shown on the external ammeter and voltmeter to the amps and volts displayed on the front panel of the machine.
8. If the readings shown on the front panel displays are about the same or very close to the reading on the external meters, the feedback is probably good, and this test is complete.
9. If the readings differ significantly, continue with this procedure
10. Turn off the engine and release the load from the weld terminals. (The load bank and ammeter should remain connected, but the load should be released.)
11. Perform the **Case Cover Removal Procedure**.
12. Locate plugs P3 and P6 on the control PC board. See figure #1. Remove the plugs and check for dirt, corrosion, damaged, expanded, or incorrectly positioned terminals. Repair or replace wiring components as needed and reconnect the plugs to the control board.
13. Restart the machine and apply a load across the weld terminals that measures about 200 amps. If the machine will not produce 200 amps of current, apply as much load as you can.
14. Using the voltmeter, measure and note the DC voltage at the weld output terminals.
15. Check the voltage between leads #204S+ (P6-1) and lead #208B- (P3-15) at the control PC board Molex plugs. The voltage should be the same as was measured at the weld terminals.

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TROUBLESHOOTING & REPAIR

WELD CONTROL FEEDBACK TEST (*continued*)

16. If the voltage readings are different, check the wiring and connections between the welding terminals and the control PC board. See the wiring diagram.
17. Connect the millivolt meter probes between lead #206S+ (P6-2) and lead 204S- (P6-1). See Wiring Diagram. If the machine is currently producing 200 amps the millivolt meter should read about 25 millivolts.
18. If the machine cannot produce 200 amps of weld current, the correct millivolt signal will need to be calculated by dividing the reading displayed on the external ammeter by 8. See the following explanation.
19. The shunt used in this machine will produce 50 millivolts at a load of 400 amps, or 8 amps per millivolt.
20. To calculate the correct millivolt signal for a given load, you divide the number of amps displayed on the ammeter by 8.

Example: If your ammeter reads 75, ($75/8 = 9.4$) If the shunt is working correctly, and the wiring between the shunt and the control PC board is in good condition, the meter connected at the control PC board should be reading about 9.4 millivolts.
21. If the millivolt reading is incorrect, check the wiring between the shunt and the control PC board for damage, grounds, and faulty connections. If the wiring is good, the shunt and lead assembly is faulty and should be replaced.
22. Perform the **Case Cover Replacement Procedure**.

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CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will check the Output Control potentiometer, Arc Control potentiometer, Mode Switch, and associated wiring for damage, proper operation, tracking, and grounds.

MATERIALS NEEDED

- Digital Ohmmeter
- Wiring Diagram
- Control Inner-Connection Diagram

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TROUBLESHOOTING & REPAIR

CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST (continued)

TEST PROCEDURE

1. Turn the engine off
2. Perform the **Case cover Removal Procedure**.
3. Unplug P7 from control board, see control Inner-connection diagram, and visually check the plug and attached wiring for damage, corrosion, improperly seated or damaged contact pins. P7 will remain unplugged for following test.
4. Set the mode switch in the "CC-Stick" position.
5. Test the resistance between each of the leads in P7 and a good clean chassis ground connection. Be very careful that the connection pins in P7 are not damaged or spread out.
6. The resistance should be very high. A reading of 500,000 (500k) ohms or higher is acceptable.
7. If the resistance is lower than 500k Ohms, replace the potentiometer and mode switch plug and lead assembly, or replace the defective component within the assembly. See wiring diagram.
8. Perform the resistance tests per **Table F.3**.
9. If the resistance readings are not as specified in the table, replace the potentiometer and mode switch plug and lead assembly, or replace the defective component. See the wiring diagram.
10. If testing is complete, plug P7 back into the control PC board and perform the **Case Cover Replacement procedure**.

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TROUBLESHOOTING & REPAIR

CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST (continued)

TABLE F.3

POT/MODE SWITCH RESISTANCE TEST		
MODE SWITCH SETTING	OHMMETER CONNECTION	OHMMETER READING
CC-STICK	P7-9 (#214) TO P7-14 (#218)	500K or Higher
CC-STICK	P7-9 (#214) TO P7-15 (#220)	500K or Higher
CC-STICK	P7-9 (#214) TO P7-16 (#222)	500K or Higher
CC-STICK	P7-14 (#218) TO P7-15 (#220)	500K or Higher
CC-STICK	P7-14 (#218) TO P7-16 (#222)	500K or Higher
CC-STICK	P7-15 (#220) TO P7-16 (#222)	500K or Higher
TOUCH START TIG	P7-15 (#220) TO P7-16 (#222)	*
DOWNHILL PIPE	P7-14 (#218) TO P7-16 (#222)	*
CV-WIRE	P7-9 (#214) TO P7-16 (#222)	*
N/A	P7-5 (#75) TO P7-1 (#77)	about 10K
N/A	P7-1 (#77) TO P7-4 (#76)	Ohms values should sweep smoothly from 10K to 0 when ARC CONTROL is turned from Min. to Max.
N/A	P7-6 (#279) TO P7-8 (#277)	about 10K
N/A	P7-8 (#277) TO P7-7 (#278)	Ohms values should sweep smoothly from 10K to 0 when ARC CONTROL is turned from Min. to Max.
* Resistance should be very low, The Ohmmeter should read about the same value as one would get by touching the two meter probes together.		

If the resistance readings are not as specified in the table, replace the potentiometer and mode switch plug and lead assembly, or replace the defective component. See the Wiring Diagram.

if testing is complete, plug P7 back into the control PC board and perform the **Case Cover Replacement Procedure**.

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TROUBLESHOOTING & REPAIR

REMOTE RECEPTACLE RESISTANCE TEST

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will help determine if there is a problem with the remote receptacle control wiring, relating to electrical tracking between other control conductors, power conductors, or ground. This test also checks the function of the weld terminal switch.

MATERIALS NEEDED

- Ohm Meter
- Wiring Diagram
- Control Inner-Connection diagram

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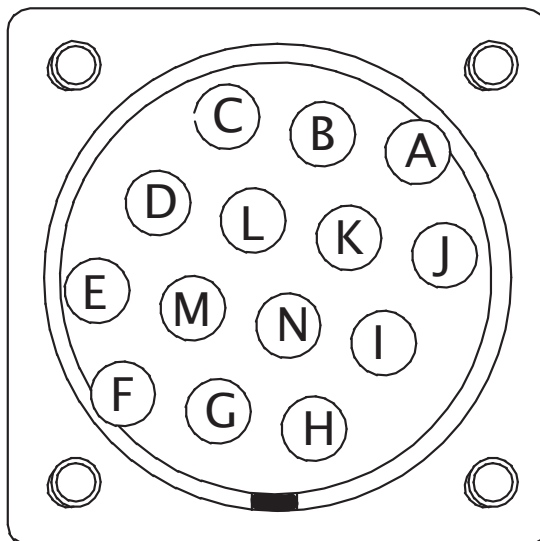
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TROUBLESHOOTING & REPAIR

REMOTE RECEPTACLE RESISTANCE TEST (*continued*)

FIGURE F.18

AMPHENOL 1



TEST PROCEDURE

1. Turn the machine off.
2. Perform the **Case Cover Removal Procedure**.
3. Make sure that there are no devices of any kind plugged into either Amphenol receptacles.
4. Remove Molex plug P1 from the control PC board, see Control Inner-Connection Diagram. Examine the Molex plug and the receptacle on the control PC board for dirt, corrosion, damaged or out-of-position pins. Repair or replace any damaged components. Position the P1 plug so it can not make electrical contact with any other conductor or chassis ground.
5. Perform the following resistance tests shown in the following table. Be very careful not to damage or spread any of the connection pins in the Amphenol receptacle. **See Table F.4.**
6. If the measured resistance does not meet values specified, check for damage, dirt or moisture contamination in the Amphenol receptacles and the P1 Molex plug. Check for damaged or grounded wiring.
7. If the resistance values are found to be too low, due to contaminated electrical components in the Amphenol harness assembly. Try removing the contamination and drying the components completely. If the resistance values are still too low, replace the Amphenol harness assembly.
8. If the values are incorrect for the last two tests in the table, (Pin C to Pin D) check the welding terminal switch and the wiring connected to that switch. See the wiring diagram. Repair any faulty connections or replace the switch if necessary.
9. Plug P1 back into the Control Pc board.
10. Perform the **Case Cover Replacement Procedure**.

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TROUBLESHOOTING & REPAIR

REMOTE RECEPTACLE RESISTANCE TEST (continued)

TABLE - F.4

AMPHENOL RESISTANCE TEST		
WELDING TERMINAL SWITCH SETTING	OHMMETER CONNECTION	OHMMETER READING
N/A	PIN "G" (#75B) to PIN "A" (#32)	500K or Higher
N/A	PIN "G" (#75B) to PIN "B" (GND-A)	500K or Higher
N/A	PIN "G" (#75B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "E" (#77B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "F" (#76B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "H" (#21)	500K or Higher
N/A	PIN "G" (#75B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "G" (#75B) to PIN "J" (#31)	500K or Higher
N/A	PIN "G" (#75B) to PIN "K" (#42A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "A" (#42)	500K or Higher
N/A	PIN "F" (#76B) to PIN "B" (GND-A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "E" (#77B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "H" (21)	500K or Higher
N/A	PIN "F" (#76B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "J" (#31)	500K or Higher
N/A	PIN "F" (#76B) to PIN "K" (#42A)	500K or Higher
N/A	PIN "E" (#77B) to PIN "A" (#32)	500K or Higher
N/A	PIN "E" (#77B) to PIN "B" (GND-2)	500K or Higher
N/A	PIN "E" (#77B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "E" (#77B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "E" (#77B) to PIN "H" (#21)	500K or Higher
N/A	PIN "E" (#77B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "E" (#77B) to PIN "J" (#31)	500K or Higher
N/A	PIN "E" (#77B) to PIN "K" (42A)	500K or Higher
REMOTELY CONTROLLED	PIN "C" (#2B) to PIN "D" (#4B)	500K or Higher
WELD TERMINALS ON	PIN "C" (#2B) to PIN "D" (#4B)	*

*Resistance should be very low, The Ohmmeter should read about the same value as one would get by touching the two meter probes together.

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OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

The following procedure will aid the technician in removing and replacing the output rectifier bridge and the choke in the Ranger 305D.

MATERIALS NEEDED

- Miscellaneous hand tools
- Electrical joint compound (Dow Corning 340 - Lincoln T12837)

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TROUBLESHOOTING & REPAIR

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT *(continued)*

REMOVAL PROCEDURE

1. Turn the engine off.
2. Remove negative battery cable.
3. Perform the **Case Cover Removal procedure**.
4. Perform the **Chopper Module Capacitor Discharge procedure**.
5. Remove the four screws holding the case front to the base of the machine.
6. Remove all plugs and leads from the weld control and pull coil PC boards. Be sure to mark the leads and plugs so they can be properly re-connected. See wiring diagram.
7. Remove the screws holding the D4 diode bridge and the CR1 engine protection relay to the center baffle assembly, and allow these components to remain attached to the case front wiring.
8. Remove any additional wiring and cable ties as needed. Carefully mark leads for accurate re-connection.
9. Swing the case front to the side to permit access to the Output Rectifier and Choke.

Removing the Output Rectifier

10. Remove the heavy leads from the output rectifier. Carefully mark the leads for accurate re-connection, and also note the order and position of multiple lead connections.
11. Remove the nuts and lock washers holding the Output Rectifier to the mounting bracket. You will need to reach through the large access holes on either side of the rectifier to reach these nuts.
12. Remove the Output Rectifier from the machine.

Removing the Output Choke

1. Remove the heavy leads from the choke. Carefully mark the leads for accurate re-connection, and also note the order and position of the leads in multiple lead connections.
2. Remove the three long bolts, lock washers and nuts holding the choke the mounting bracket in the machine base. Note that there is no bolt in the lower right corner of the choke.
3. Carefully remove the choke.

REPLACEMENT PROCEDURE

Replacing the Output Choke

1. Place the choke into the machine so that the three mounting holes in the choke line up with the holes in the mounting bracket.
2. Insert the three long bolts through the choke and the mounting bracket. Place a lock washer and nut on the end of each bolt and tighten.
3. Reconnect the choke leads. Position the leads, bolts, washers, and nuts exactly as they had been originally connected. Tighten the connection securely.

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TROUBLESHOOTING & REPAIR

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT(*continued*)

Replacing the Output Rectifier

1. Place the Output Rectifier into the machine so that its mounting studs fit into the holes in the bracket. Place a lock washer and a nut on each stud and tighten.
2. Apply a thin film of electrical joint compound, (Dow Corning 340 - Lincoln T12837) between the surfaces of the "W" leads and the Output Rectifier. Reconnect the Output Rectifier, positioning the leads, bolts, washers, and nuts exactly as they had been originally connected. Tighten all of the connections securely. See Wiring Diagram.
3. Swing the case front back into position.
4. Mount the D4 diode bridge and the CR1 engine protection relay to the center baffle assembly. See Wiring Diagram.
5. Attach the case front to the machine base with four screws.
6. Reconnect all of the leads and plugs that were disconnected during the removal procedure, and replace any cable ties that were removed.
7. Perform the **Case Cover Removal Procedure**.

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CHOPPER MODULE REMOVAL AND REPLACEMENT

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Chopper Module Assembly.

Note: The Chopper Module assembly is removed and replaced as a unit. It contains no serviceable parts.

MATERIALS NEEDED

- Miscellaneous hand tools
- Electrical thermal joint compound - (Dow Corning 340 - Lincoln T12837)

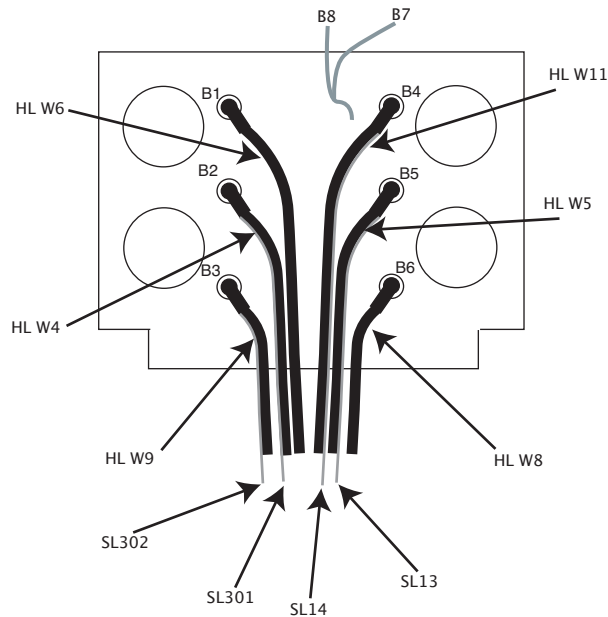
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TROUBLESHOOTING & REPAIR

CHOPPER MODULE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.19 – EXCITER LEADS T1, T2, T3



PROCEDURE

Removal

1. Turn the engine off.
2. Perform the **Case Cover Removal Procedure**.
3. Perform the **Power Module Capacitor Discharge procedure**.
4. Disconnect leads 23 and 25 at their in-line couplings.
5. Using the 7/16" socket wrench, remove the following leads. Label the leads before removal. Cut cable ties as needed. Note placement of leads and fasteners: screw, lock washer, flat washer, small lead, heavy lead.
6. Using a 3/8" socket wrench, remove the three screws holding the power module assembly to its brackets on the vertical baffle. Remove the plastic strip with the top two screws. Be sure to support the Power Module as you remove the last screw.
7. Remove the Power Module assembly from the machine.

TERMINAL	LEADS
B4	Heavy lead W11, small lead 14
B5	HL W5, SL 13
B6	HL W8
B1	HL W6
B2	HL W4, SL 301
B3	HL W9, SL 302

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RANGER 305D



TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT

WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This following procedure will aid the technician in removing and replacing the stator and rotor for repair or replacement.

MATERIALS NEEDED

- Miscellaneous hand tools
- Gear puller
- Hoist, chains, straps
- .017" by .5" wide feeler gauge for air gap
- Rubber, plastic or wooden mallet
- Wooden blocks, or equivalent, (to support engine)

(Right handed thread, CT to tighten, CCW to loosen)

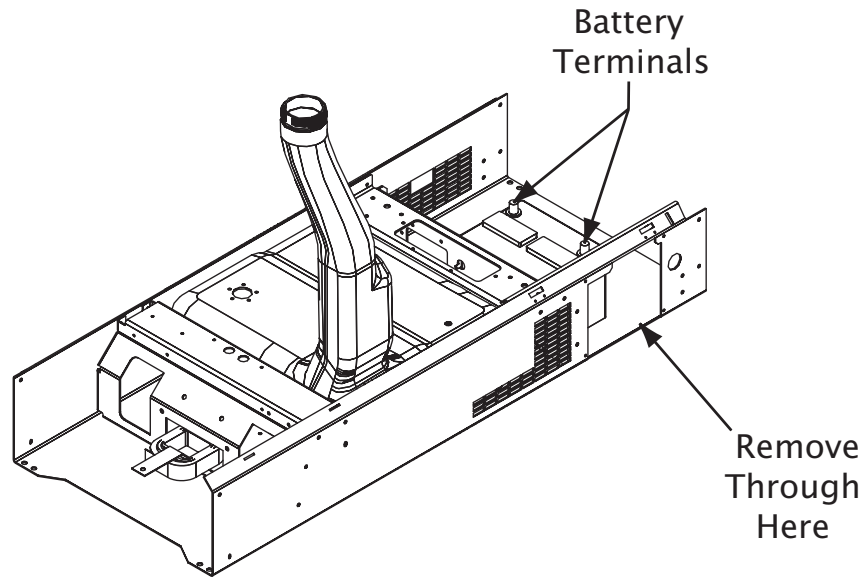
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TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT (*continued*)

FIGURE F.20 – BATTERY PLACEMENT



TEST PROCEDURE

1. Turn engine off.
2. Position the machine on a firm, safe work surface with adequate space to work around the machine. A hoist will be needed; with a reach extending from the lift bale to several feet behind the radiator end of the machine.
3. Perform the **Case Cover Removal Procedure**.
4. Perform the **Chopper Module Capacitor Discharge Procedure**.
5. Remove the four screws holding the battery access panel to the base.
6. Disconnect the battery cables. **REMOVE THE NEGATIVE BATTERY CABLE FIRST**, and then remove the positive cable.
7. Loosen the battery retaining nuts and unhook the long carriage bolts from the slotted holes in the engine support bracket. Remove the bolts and battery retaining bracket.
8. Slide the battery out of the base through access hole in the side. See Figure F.20.
9. Drain radiator and disconnect the radiator hoses and the overflow tube.
10. Remove the six screws holding the radiator frame to the base. Remove the radiator and frame assembly.
11. Remove the coolant recovery tank by pulling it straight up and off of its mounting bracket.
12. Remove the air filter assembly from its bracket; it may remain connected to the engine air intake hose.
13. Remove the filter bracket by removing the two nuts and bolts holding it to the engine mounting bracket.
14. Clearly mark all stator leads to insure proper reconnection. See wiring diagram.
15. Disconnect all of the stator winding leads. Note how the leads are routed and connected as well as the order and placement of leads and hardware for each connection. See wiring diagram and the Control Inner-Connection Diagram.
16. Unwrap the #3 and #6 leads from the toroidal current transformer and pull all of the stator leads through the hole in the center baffle assembly. All of the leads connected to the stator winding should now be clear so nothing can bind when the stator is removed later in this procedure. **See Figure F.21**. See Wiring Diagram.
17. Remove the two screws and nuts holding the brush holder bracket to the stator frame. The brush holder and bracket assembly can now be removed.
18. Remove the wiring attached to the alternator side of the engine. This includes the connections to the alternator, starter, oil pressure switch, and engine ground cables and wires. Be sure to mark leads for accurate re-connection. **See Figure F.22**.

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TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.21 – WIRE GUIDE HOLE

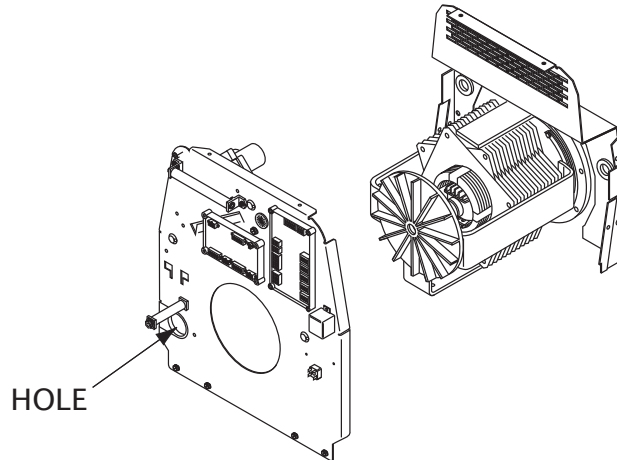
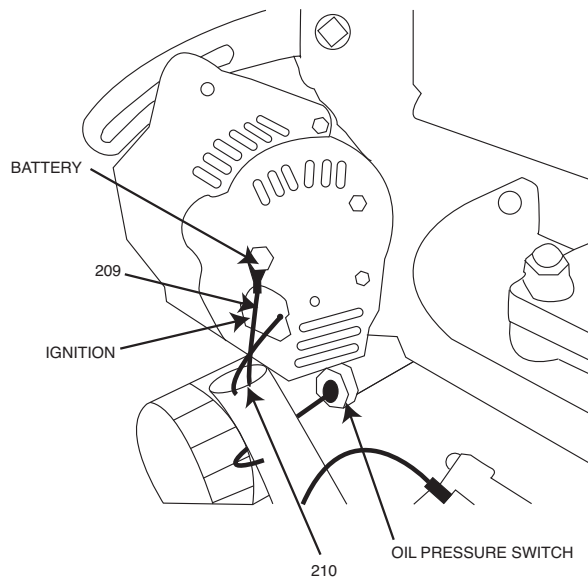


FIGURE F.22 – ALTERNATOR LEADS



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TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT (*continued*)

19. The wires connected to the solenoid side of the engine can remain attached, in most cases.
20. Compress the spring clamp and remove the fuel line from the fuel filter/shut-off valve. Pull the line out of the hole in the engine baffle, and then plug the line and the opening in the filter housing to prevent fuel leakage and contamination.
21. Remove the fuel return line from the fitting in the top of the fuel tank. Plug this line and fitting as well.
22. Remove the engine baffle.
23. Attach the hoist to the lift bale and raise the hoist until it just begins to support some of the weight of the generator and engine.
24. Remove the two nuts holding the generator to the support bracket, and the two screws holding the engine support brackets to the rubber engine mounts.
25. Raise the hoist to lift the engine and generator assembly just high enough to clear the generator mounting studs. The center baffle will need to be gently pushed forward to provide clearance between the fan and the Chopper module. In some cases, the Chopper module mounting screws may need to be loosened or removed so the chopper module can be positioned to provide additional clearance. If the chopper module screws are removed, the chopper module will need to be supported.
26. Rotate the engine and generator assembly 180 degrees and line up the engine mounting bracket to the rubber engine mounts. Be careful that the wiring still attached to the engine does not get damaged. Disconnect additional engine wiring, and/or remove additional cable ties if necessary.
27. Replace the screws, which had been removed from those mounts, and tighten.
28. Use wooden blocks or other means to securely support the flywheel end of the engine, and remove the hoist from the lift bale.
29. The generator is now in position for easy removal.
30. Remove the plastic blower and flat washer from the rotor shaft by turning the blower counter-clockwise. It may be necessary to prevent the rotor shaft from turning; a small pipe wrench can be used for this purpose. **DO NOT HOLD THE ROTOR BY THE SLIP RINGS.**
31. Use the hoist, along with lifting straps or chains to support the generator stator assembly, and then remove the screws attaching it to the engine.
32. Separate the stator assembly from the engine; in most cases, two screwdrivers can be used to pry the stator away from the engine. Be careful not to damage the mating surfaces of the engine or stator frame assembly. If the bearing is binding in the tolerance ring, it may be necessary to use a gear puller to Separate the stator frame from the engine.
33. Carefully slide the stator assembly off the rotor.

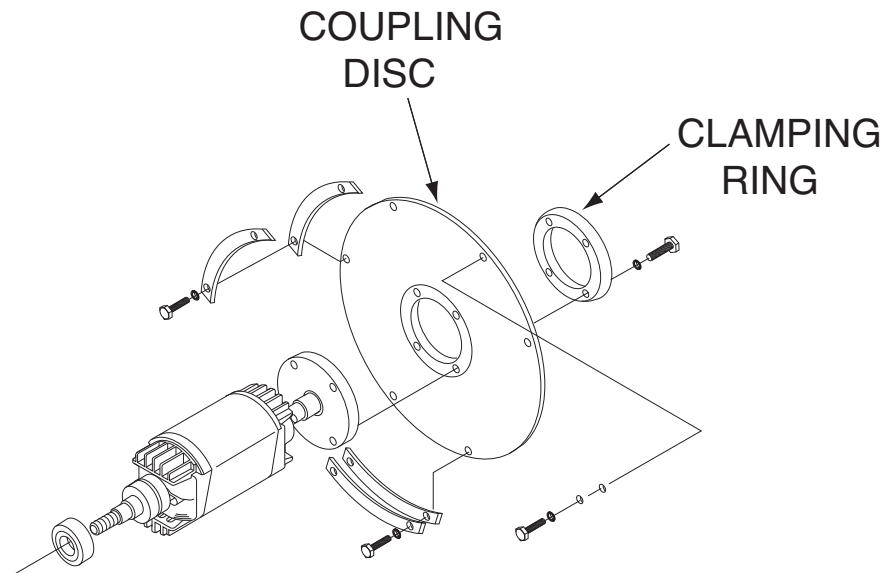
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TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT (*continued*)

FIGURE F.23 – DISC/RING LOCATION



Removing the Rotor

1. Use the hoist and lifting straps to support the rotor assembly.
2. Remove the screws and disc clamping bars from the rotor coupling disc, and remove the rotor.

NOTE: earlier machines used three 0.31" thick clamping bars and later models use six 0.14" thick clamping bars arranged in three sets of two bars each.

3. If the rotor is to be replaced, remove the screws, rotor clamping ring and coupling disc from the rotor hub.

Replacing the Rotor

1. Whenever the rotor and stator are separated, it is highly recommended that a new bearing and tolerance ring be installed when the rotor and stator are reassembled.
2. Examine the rotor, coupling disc, clamping ring, clamping bars, screws, lock washers, and the engine flywheel. Make sure that all of the parts are clean and in good condition.

3. Install a new bearing on the rotor shaft.
4. Assemble the coupling disc and clamping ring to the rotor hub. The surface of the disc with the stamping burrs should be against the rotor hub. The side of the clamping ring with the radius should be placed against the coupling disc. See Figure F.23.
5. Insert the screws with lock washers and evenly tighten to a torque of 17 to 19 Ft-Lbs.
6. Lift the rotor assembly with the hoist and lifting straps and recheck the engine flywheel and coupling disc for anything that might prevent proper seating.
7. To attach the coupling disk to the engine flywheel, align the screw holes and insert the six screws, with lock washers, through the disc clamping bars and the coupling disc and into the engine flywheel.
8. Evenly tighten all the screws to a torque of 17 to 19 Ft-Lbs.

RANGER 305D



TROUBLESHOOTING & REPAIR

STATOR/ROTOR REMOVAL AND REPLACEMENT (*continued*)

Replacing the Stator

1. Examine the stator frame assembly. Be sure the wiring, coils, mounting flange and bearing seat are clean and in good condition. Check the engine mounting flange to be sure it is clean and free of nicks, burrs, or anything that may interfere with the seating or alignment of the stator frame assembly.

NOTE: If the stator had been removed due to a bearing or tolerance ring failure, the bearing seat in the stator frame assembly must be checked for a possible oversize condition before reassembly.

2. Apply a thin film of grease to the tolerance ring and insert it into the bearing seat cavity of the stator frame assembly.
3. Use the hoist, along with lifting straps or chains to lift the stator frame assembly. Carefully align the stator to the rotor and slide the stator frame over the rotor. Be very careful not to damage either the stator or rotor.
4. Align the rotor shaft bearing to the tolerance ring; also align the screw holes in the mounting flange. Insert the 8 screws with lock washers through the stator flange and into the engine mounting flange. It may be necessary to tap the stator with a mallet to partially seat the bearing in order to get the screws started.
5. Begin tightening the screws evenly to draw the stator onto the engine mounting flange. (Bolts, stator frame to engine: 20 to 22 ft-lbs) Be very careful that the flange and bearing are seated properly and do not bind. Tighten the stator flange screws to 20 to 22 Ft-Lbs.

6. Check the air gap between the stator and the rotor. A .017" thick, 1/2" wide feeler gauge should pass between the stator and rotor.
7. Install the flat washer and then the blower fan on the rotor shaft. The fan should be hand tightened only.
8. Attach the hoist to the lift bale to support the engine and stator assembly. Remove the support blocks, remove the screws from the engine support brackets and carefully rotate the engine and generator back to its original position.
9. Make sure all of the wiring is routed correctly, and replace the fasteners securing the engine and generator.
10. Reverse the above procedures to reassemble the machine.
11. Reconnect all wiring and replace any cable ties that had been removed.
12. Refill the engine cooling system with the coolant that was drained earlier, or with a 50/50 mix of permanent type antifreeze-coolant. See the engine operator's manual for more detailed information.

RANGER 305D



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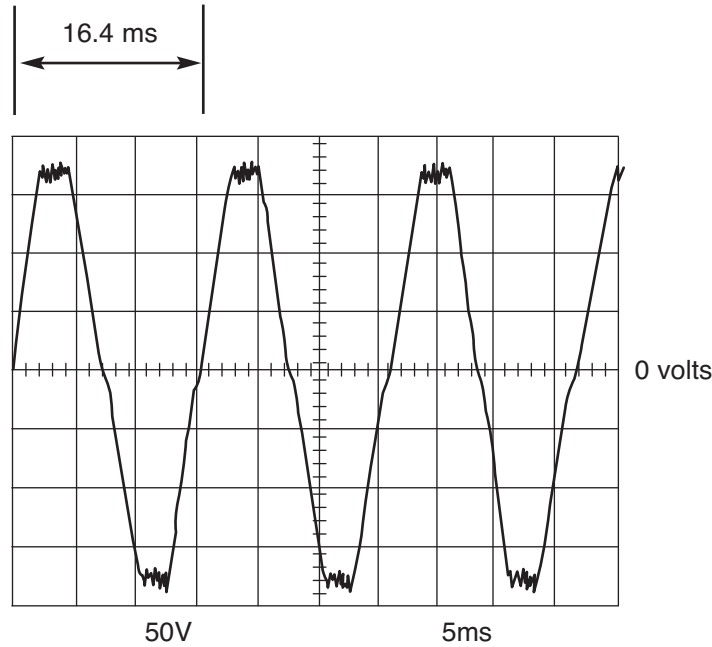
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TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (120VAC SUPPLY)

HIGH IDLE – NO LOAD



This is the typical auxiliary output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

NOTE: Scope probes are connected at machine 120 VAC receptacle.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

RANGER 305D



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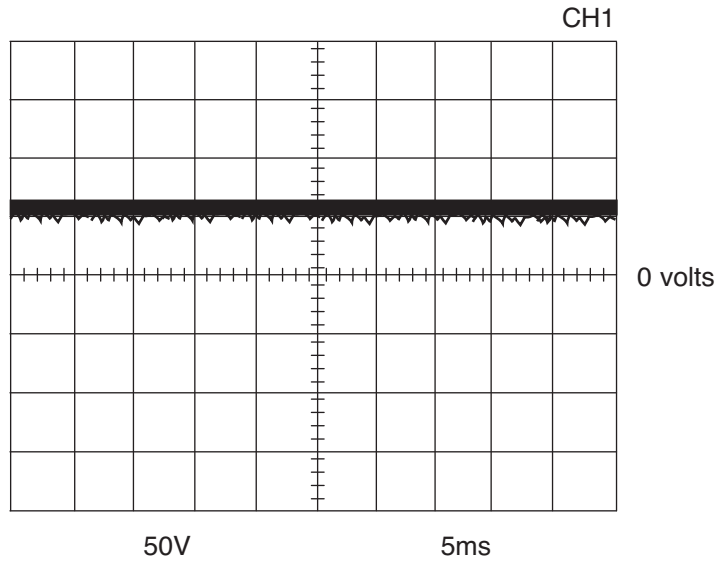
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TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (STICK)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

RANGER 305D



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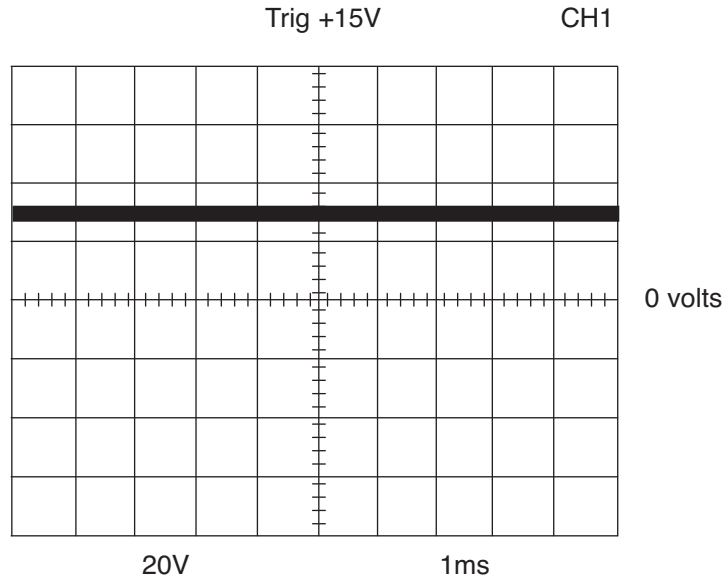
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TROUBLESHOOTING & REPAIR

NORMAL WELD VOLTAGE WAVEFORM (STICK CC)

MACHINE LOADED TO 300 AMPS AT 27 VOLTS



This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 300 amps at 27 volts.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div
Horizontal Sweep	1 ms/Div.
Coupling.....	DC
Trigger.....	Internal

RANGER 305D



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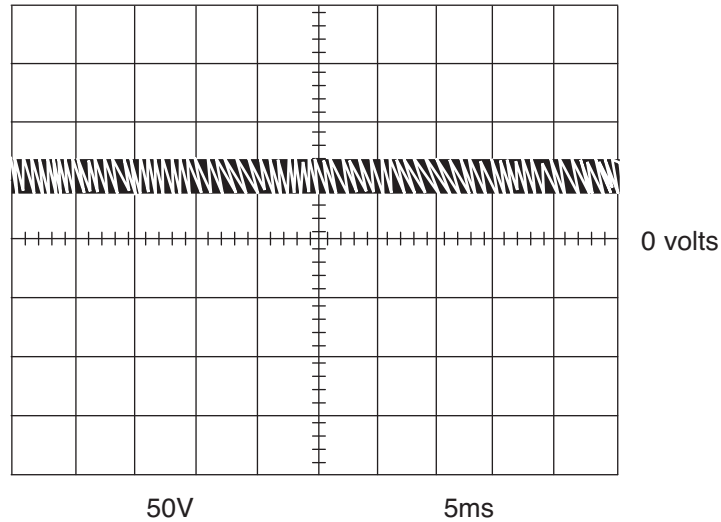
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TROUBLESHOOTING & REPAIR

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (WIRE CV TAP)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

RANGER 305D



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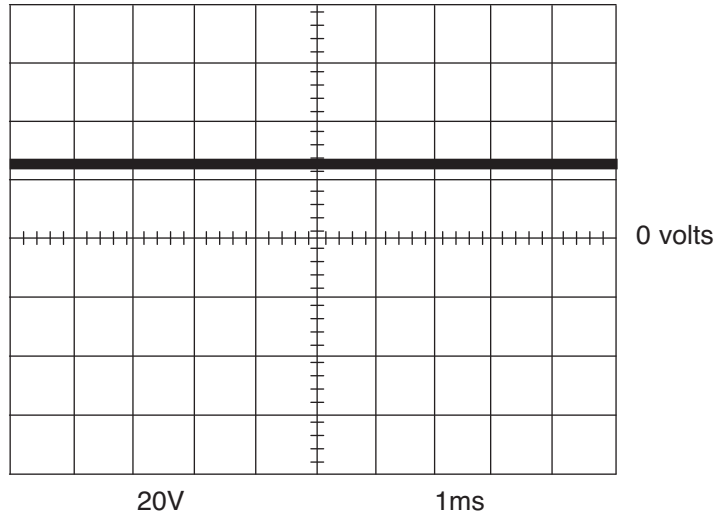
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TROUBLESHOOTING & REPAIR

NORMAL WELD VOLTAGE WAVEFORM (WIRE CV)

MACHINE LOADED TO 300 AMPS AT 28 VOLTS



This is the typical DC voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 300 amps at 28 volts.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep	1 ms/Div.
Coupling.....	DC
Trigger.....	Internal

RANGER 305D



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TROUBLESHOOTING & REPAIR

RETEST AFTER REPAIR

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any mechanical part which could affect the machine's electrical characteristics. OR
- If you repair or replace any electrical components.

ENGINE OUTPUT

Mode	No Load RPM	Load RPM
Low Idle	2400 - 2500	N/A
High Idle	3625 - 3675	3350 - 3750

WELDER DC (STICK) OUTPUT (ARC control @ -10)

Mode Selector Switch	Output Control	Open Circuit Volts	Load Volts	Load Amps
Stick (CC)	Maximum	55-60	27-32	295-325

WELDER CV (WIRE) OUTPUT (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
CV	Maximum	55-60	28-30	300
CV	Minimum	55-60	13-15	120

TOUCH START TIG (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
TIG	Maximum	10-15	20-24	240-255
TIG	Minimum	10-15	Short Circuit	18-28

AUXILIARY POWER OUTPUT

240 Volt Receptacle			120 Volt Receptacles		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
240-270*	216-240	40-45	120-135	115-130	18-22

* Upper limit reflects cold machine, voltage will be below 132/264 for machine at normal operating temperature.

42 VOLT WIRE FEEDER POWER

Open Circuit Voltage	Load Volts	Load Amps
42-46	40-44	7.0-9.0

RANGER 305D



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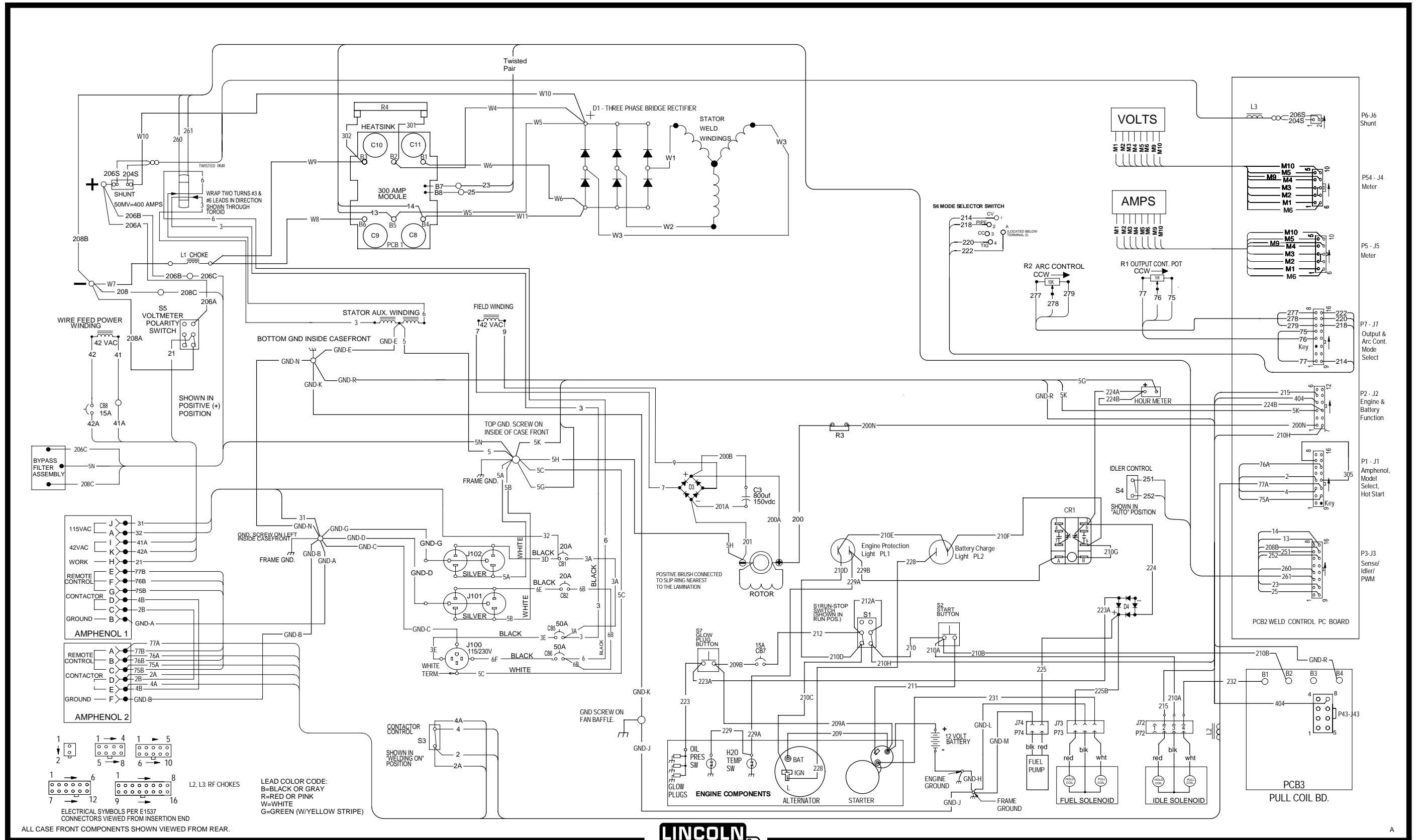
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NOTE: Many PC Board Assemblies are now totally encapsulated and are therefore considered to be unserviceable. The Assembly drawings are provided for reference only.

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RANGER 305D- KUBOTA - WIRING DIAGRAM



CLEVELAND, OHIO U.S.A.

G4250

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.



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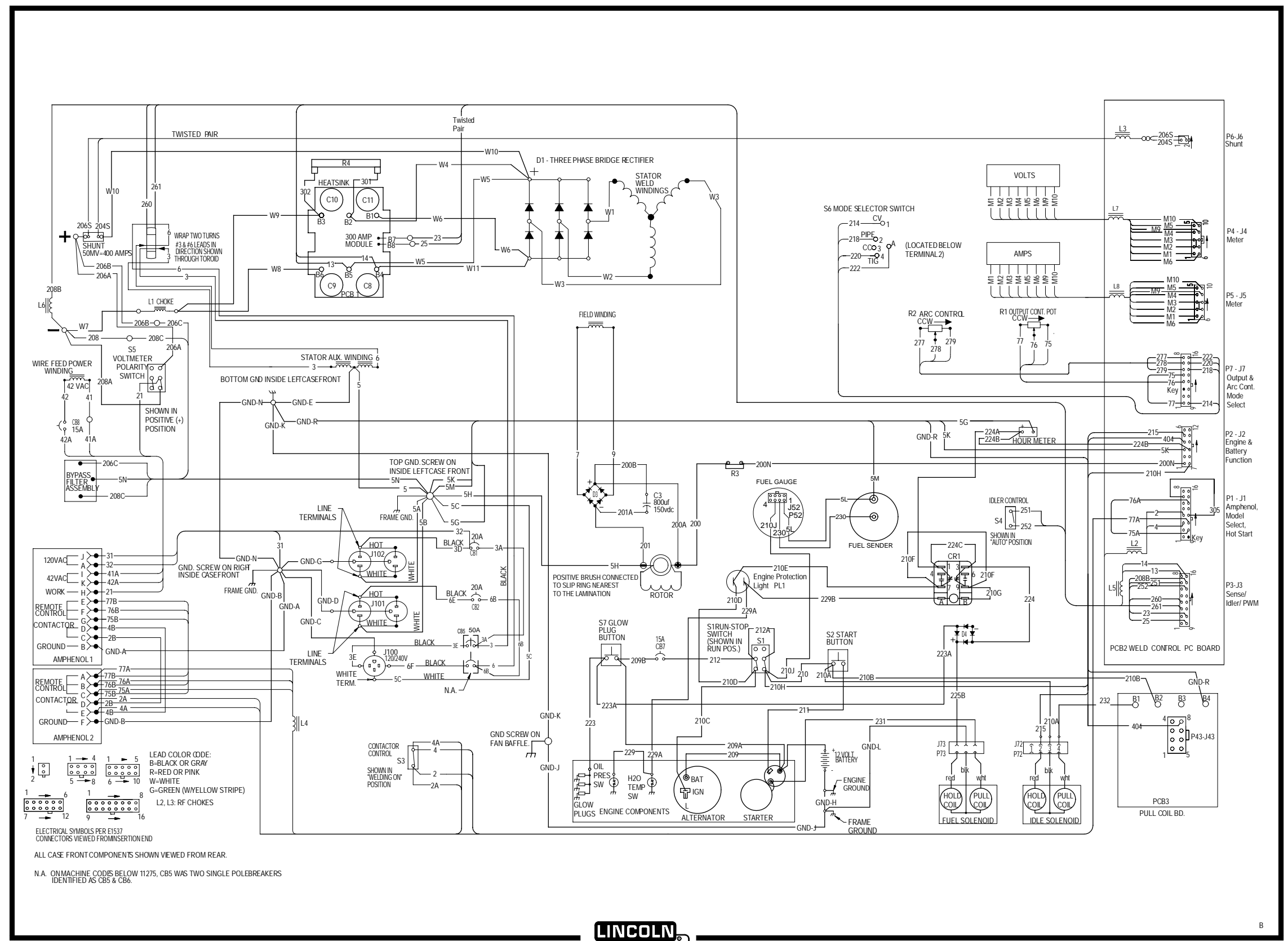
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WIRING DIAGRAM - ENTIRE MACHINE - CODES 11188, 11275 (G4571-1)

RANGER 305D- KUBOTA - WIRING DIAGRAM



CLEVELAND, OHIO U.S.A.

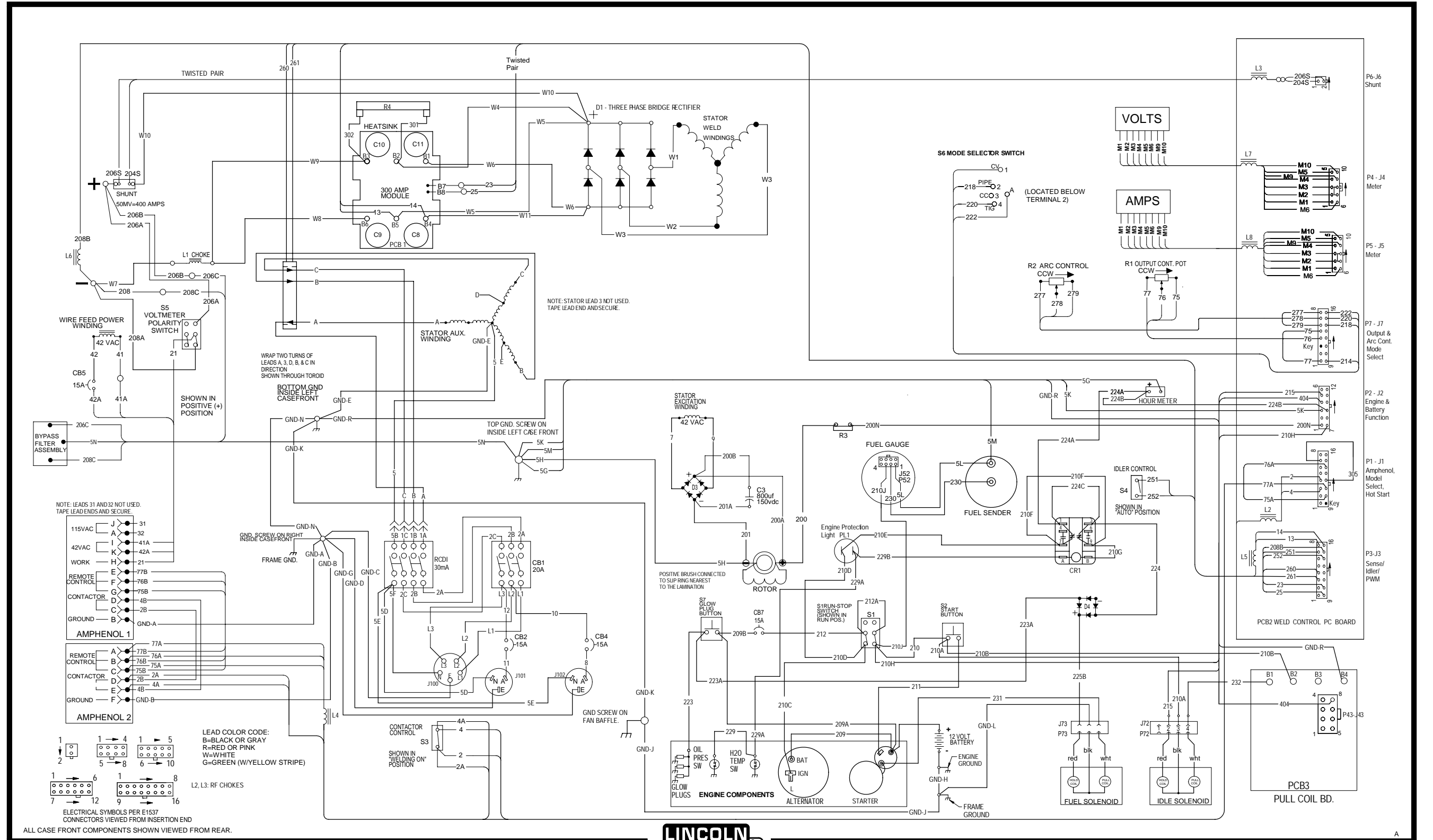
G4571-1

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.



WIRING DIAGRAM - ENTIRE MACHINE - CODES 11190, 11315 (G4573-1)

RANGER 305D CE KUBOTA WIRING DIAGRAM -EUROPE



G4573-1

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

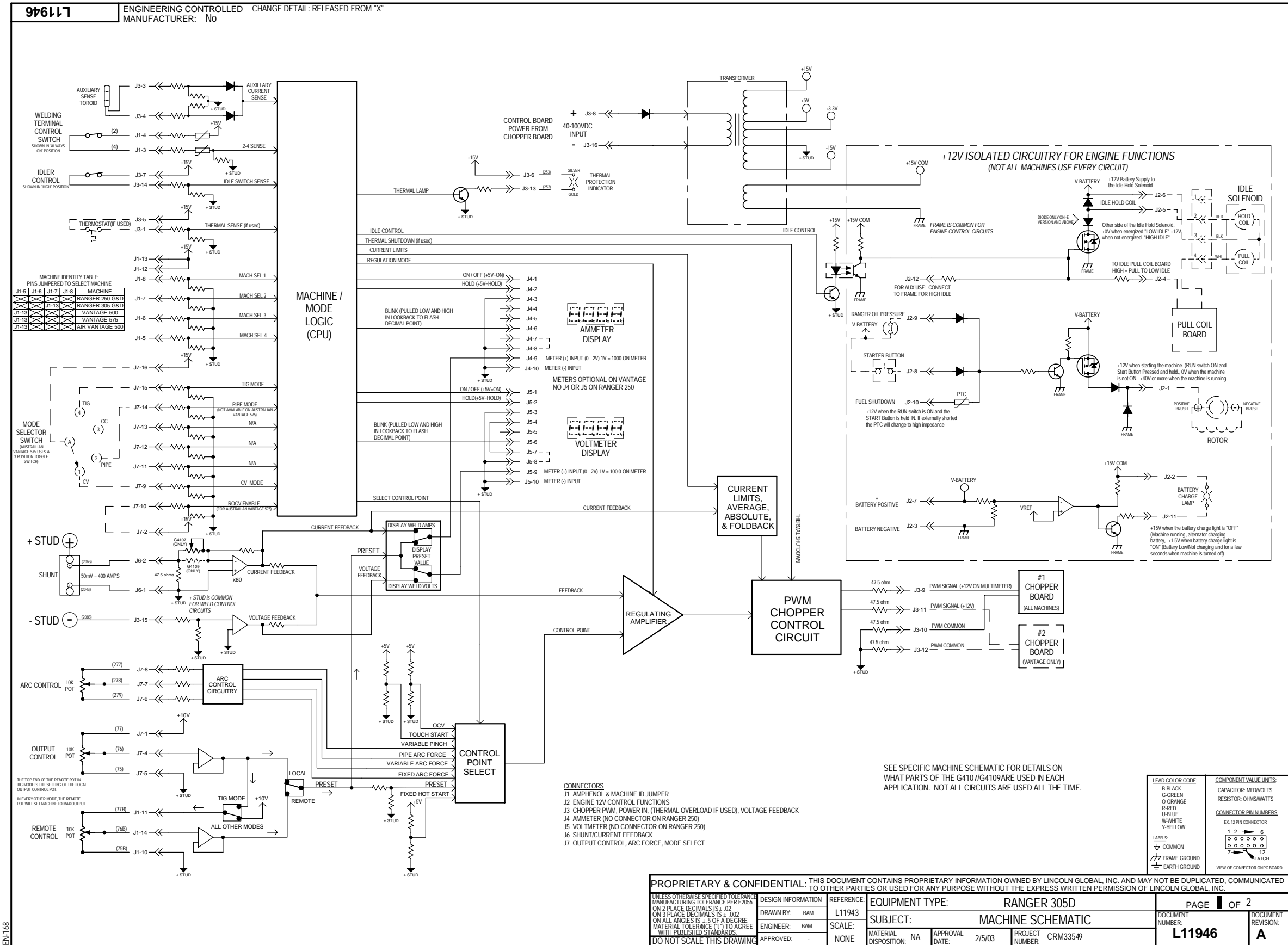


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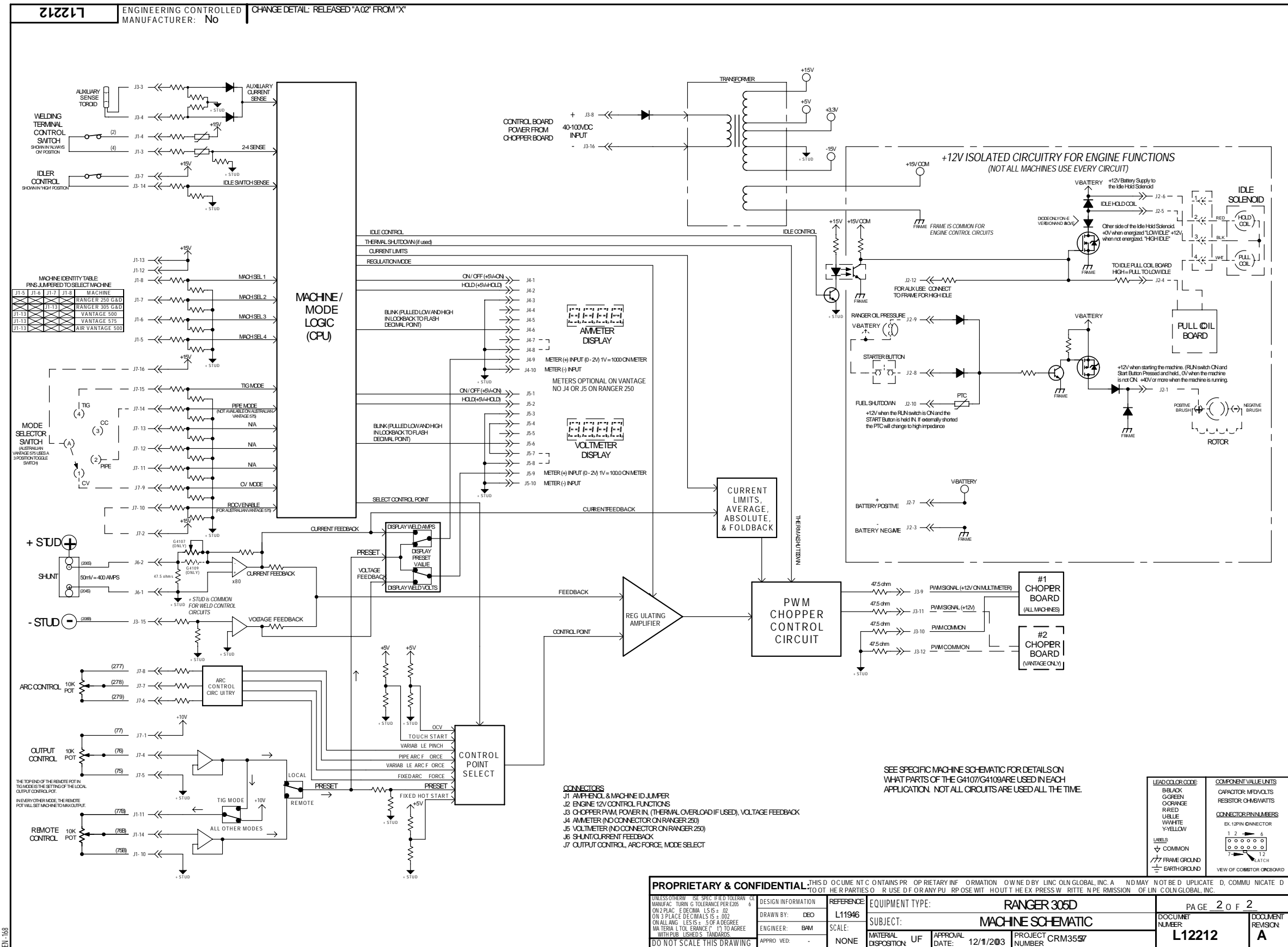
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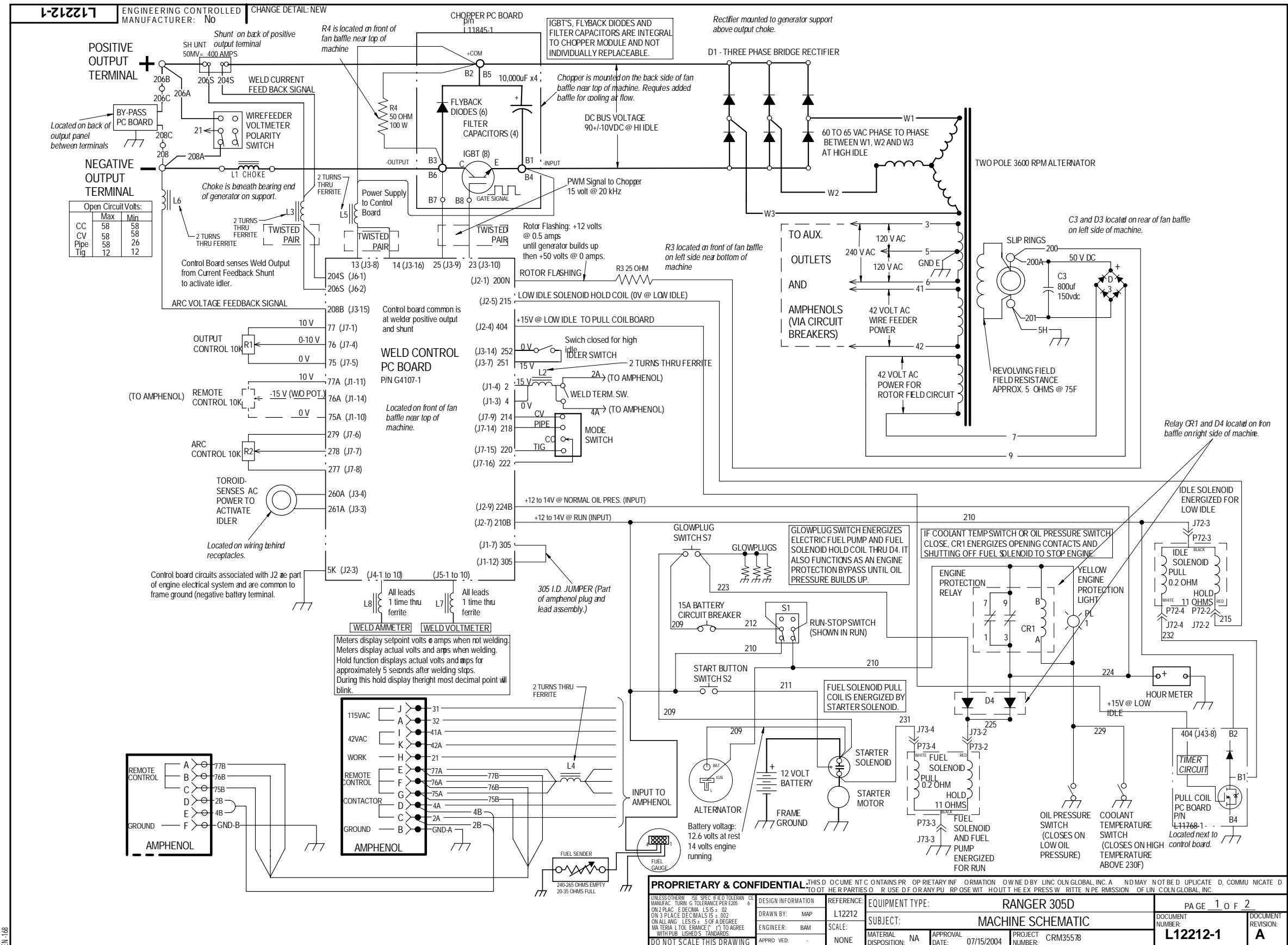
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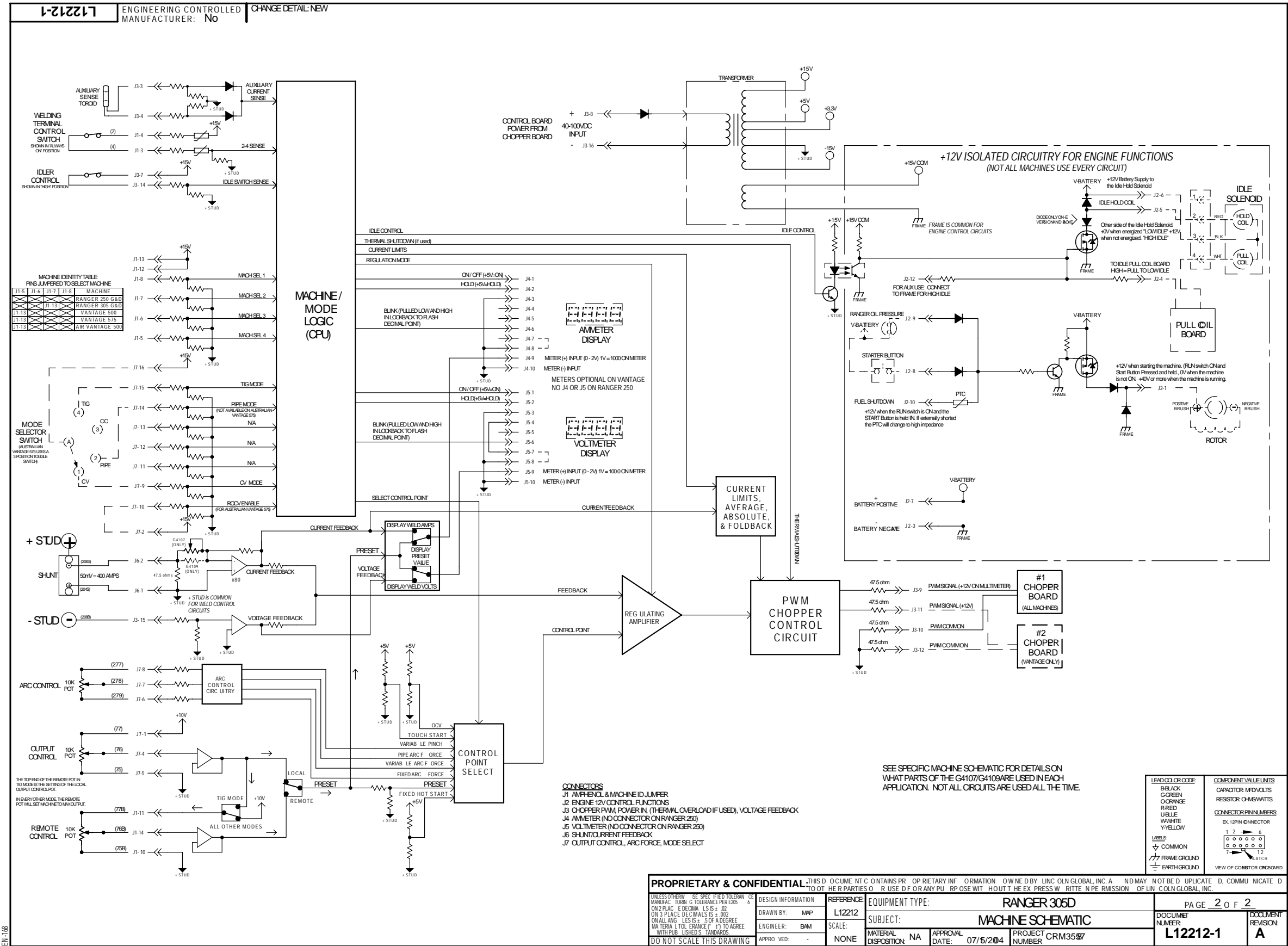


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SEE SPECIFIC MACHINE SCHEMATIC FOR DETAILS ON WHAT PARTS OF THE G4107/G4109 ARE USED IN EACH APPLICATION. NOT ALL CIRCUITS ARE USED ALL THE TIME.

LEAD COLOR CODE	COMPONENT VALUE UNITS
BLACK	CAPACITOR: MF/VOLTS
GREEN	RESISTOR: OHMS/WATTS
ORANGE	
RED	
BLUE	
WHITE	
YELLOW	

CONNECTOR PIN NUMBERS
EX: 12PIN CONNECTOR
1 2 3 4 5 6
7 8 9 10 11 12

VIEW OF CONNECTOR OR PCB BOARD

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DESIGN INFORMATION	REFERENCE	EQUIPMENT TYPE:	RANGER 305D	PAGE	2 OF 2
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ENGINEER: BWM	SCALE:	MATERIAL DISPOSITION:	NA	APPROVAL DATE:	07/5/2004
APPROVED:	NONE	PROJECT NUMBER:	CRM3537	DOCUMENT REVISION:	A

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

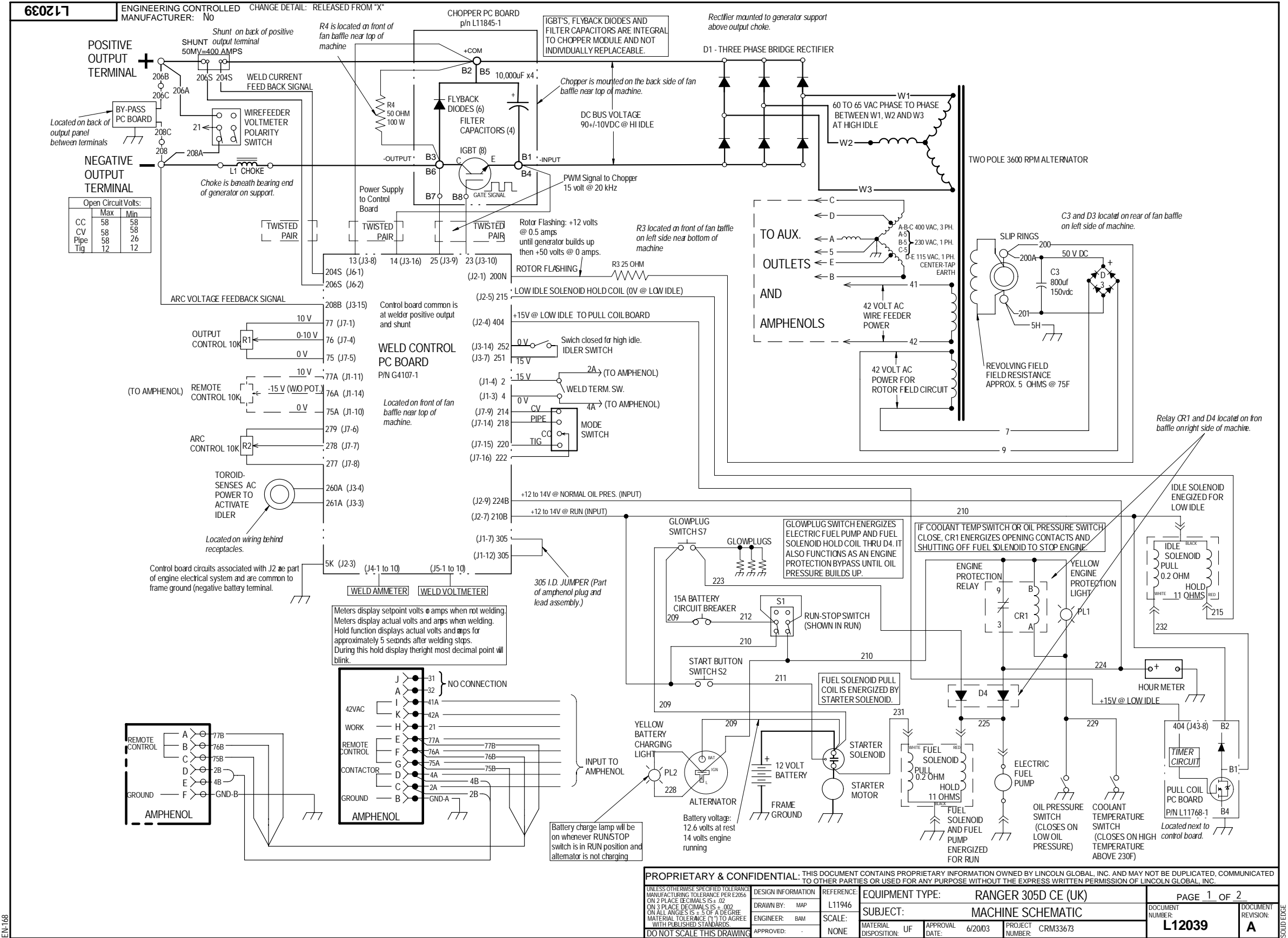


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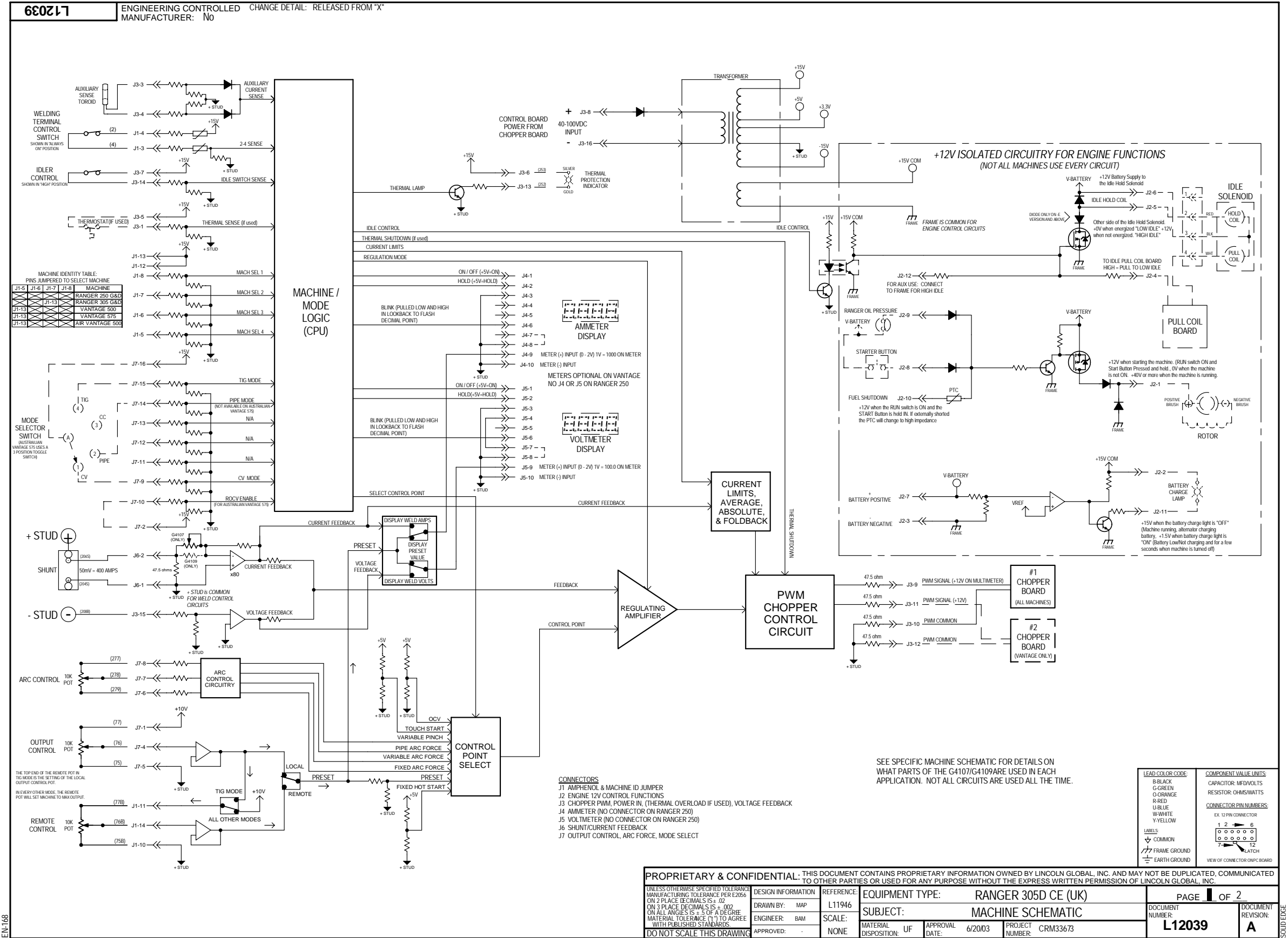
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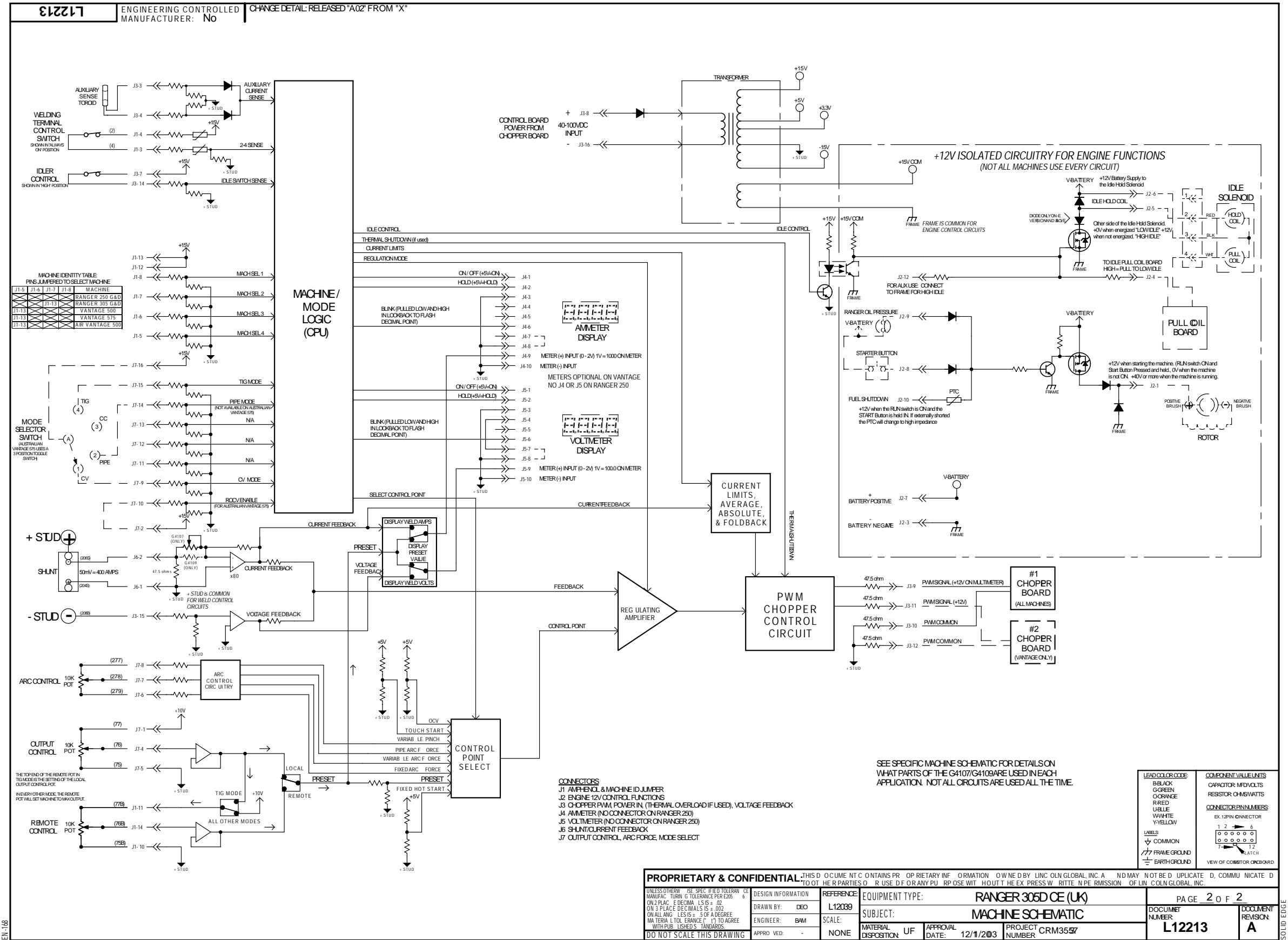
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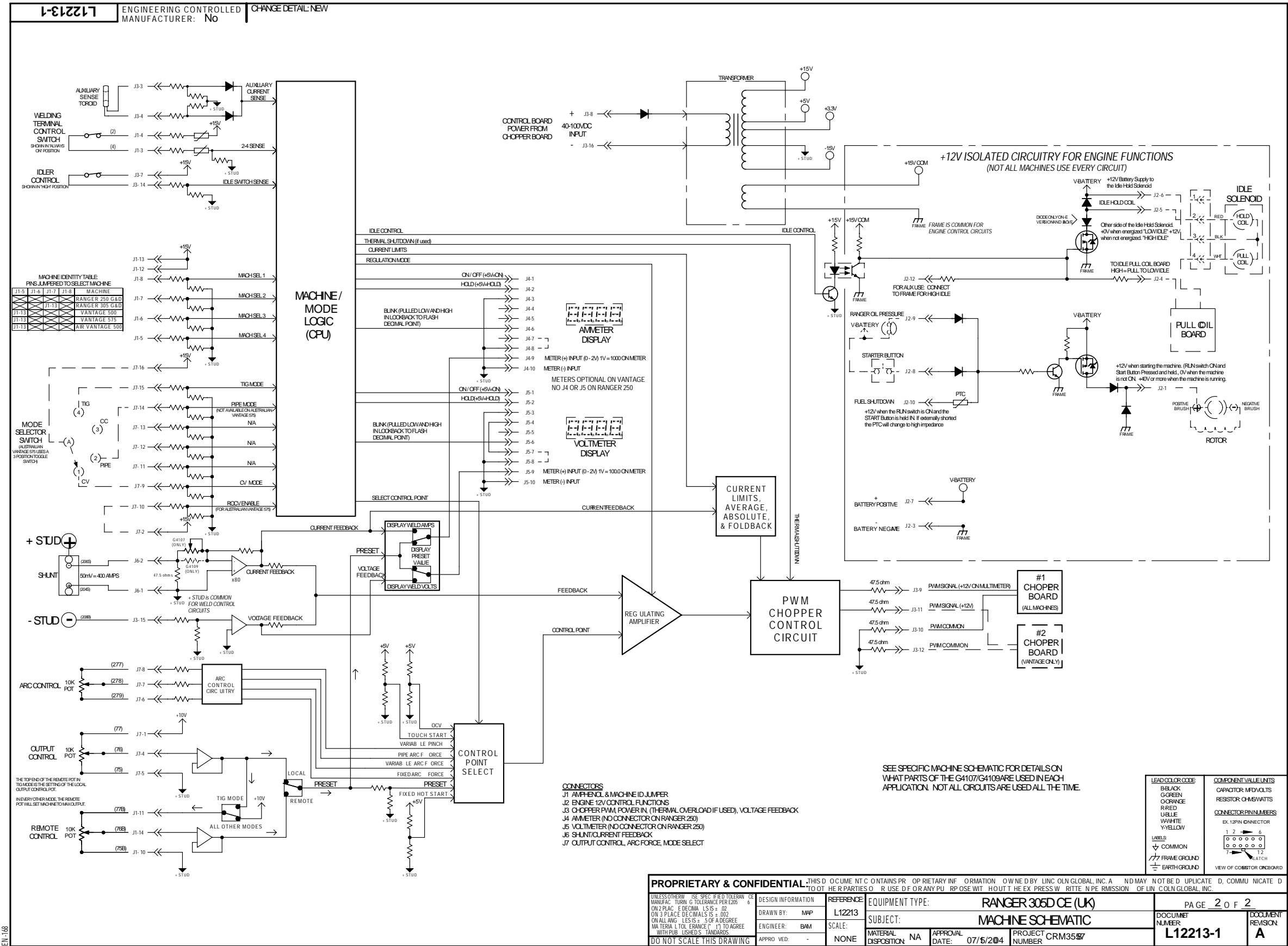
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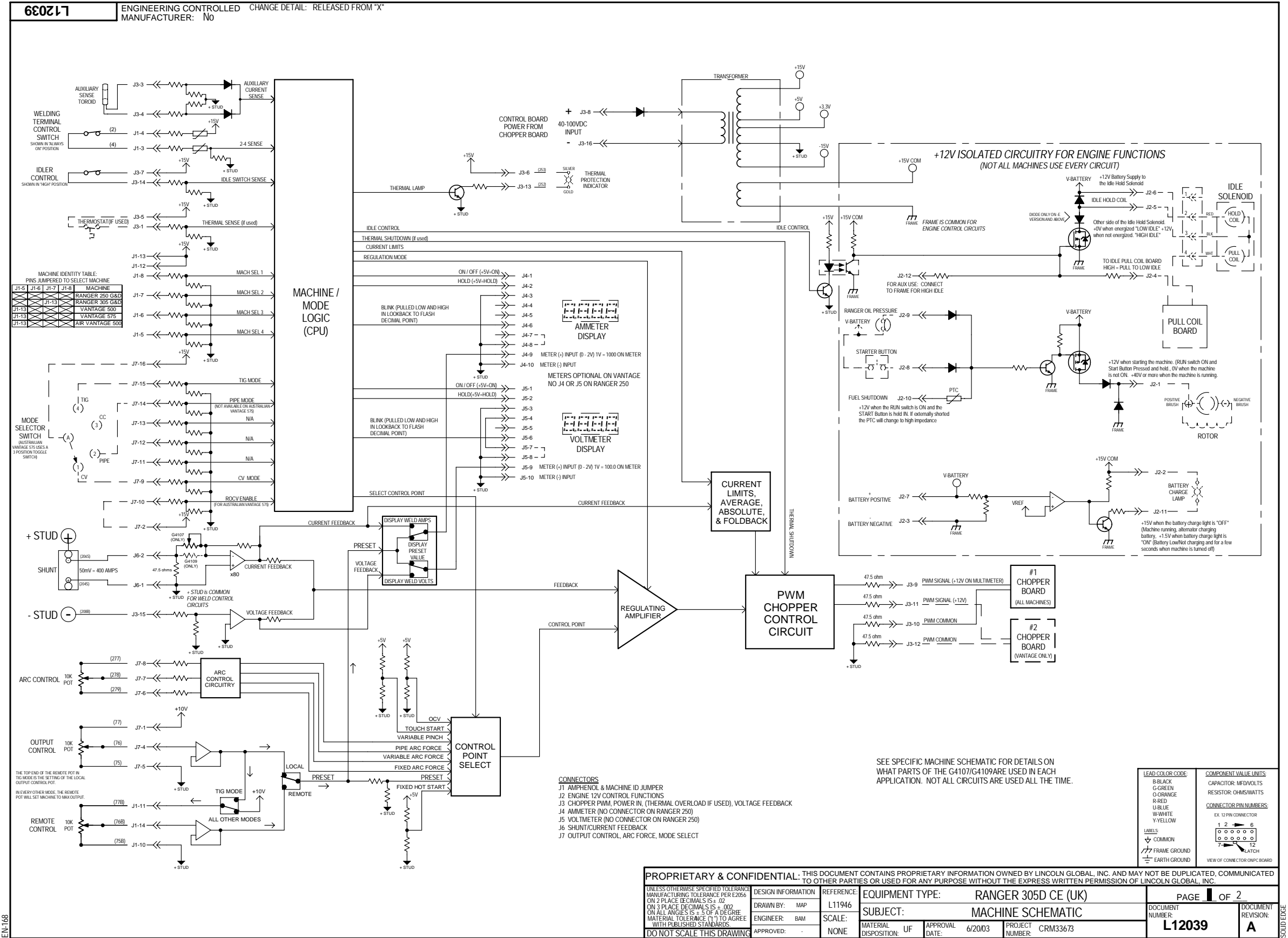


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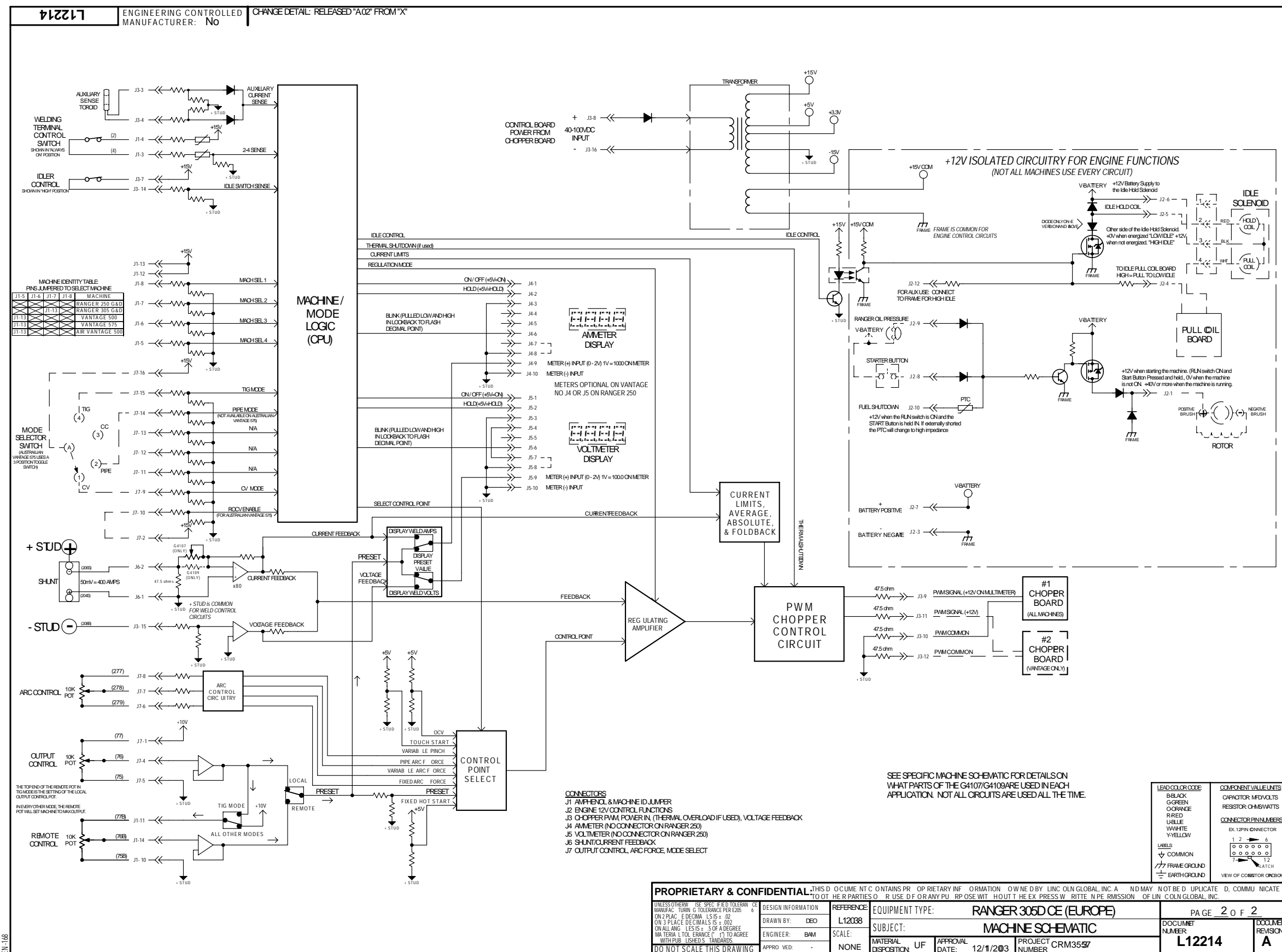
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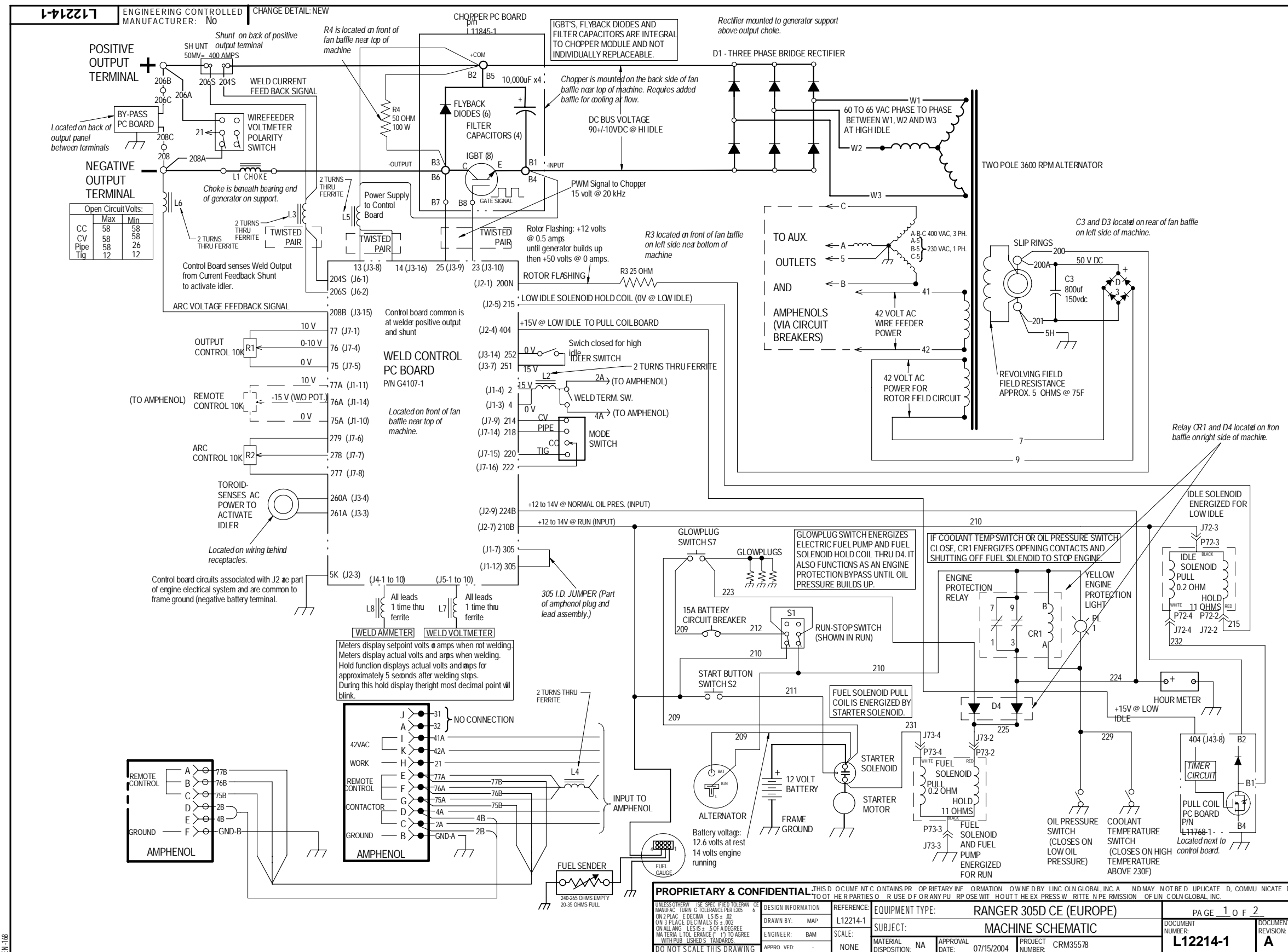


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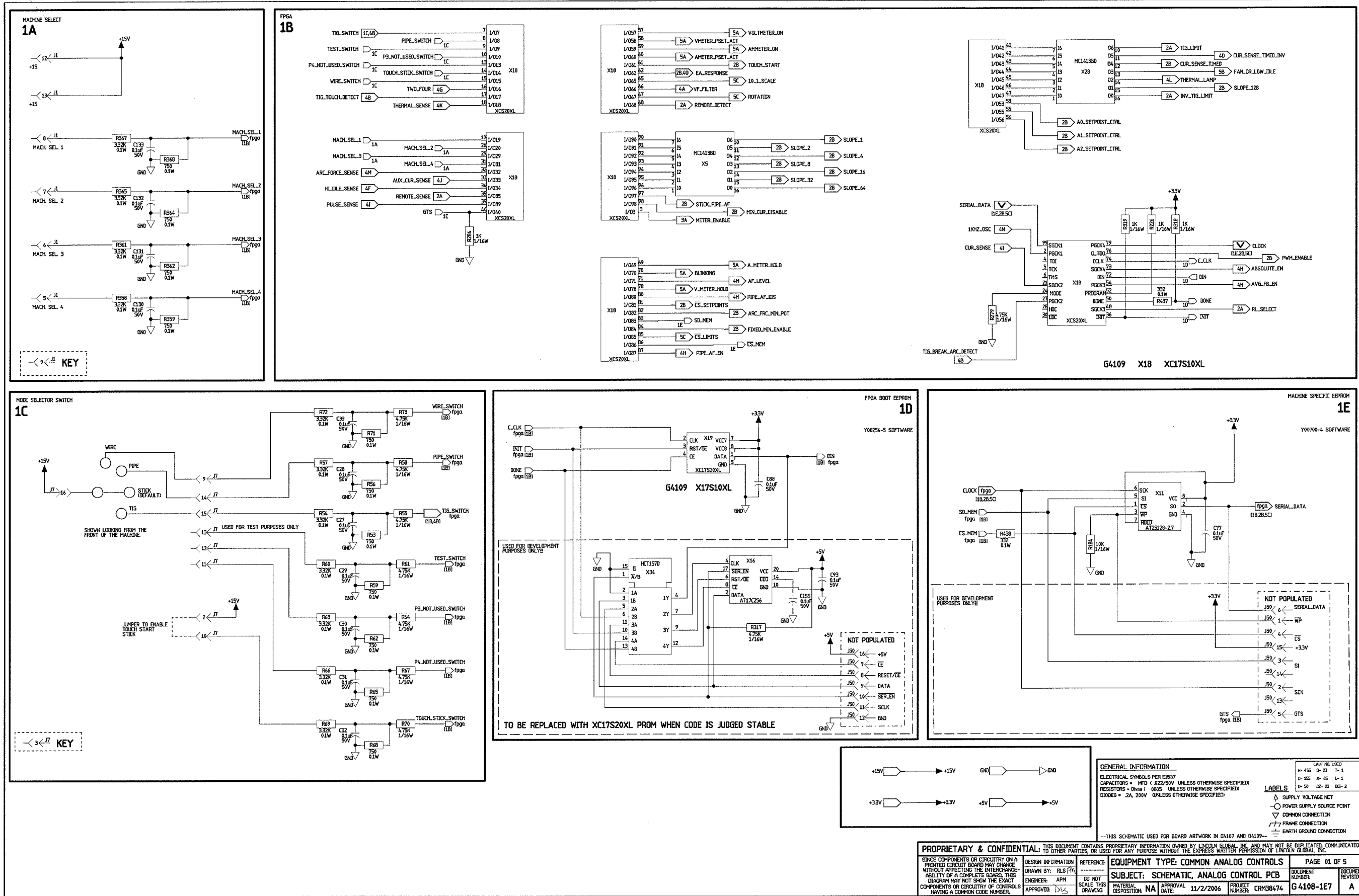


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SCHEMATIC - WELD CONTROL PC BD - ALL CODES (G4108-1) PG 1 OF 5

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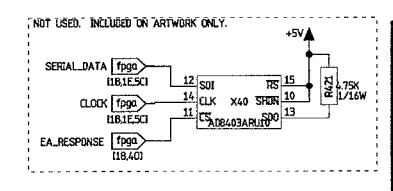
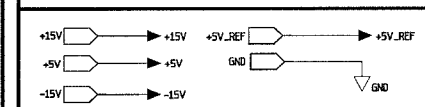
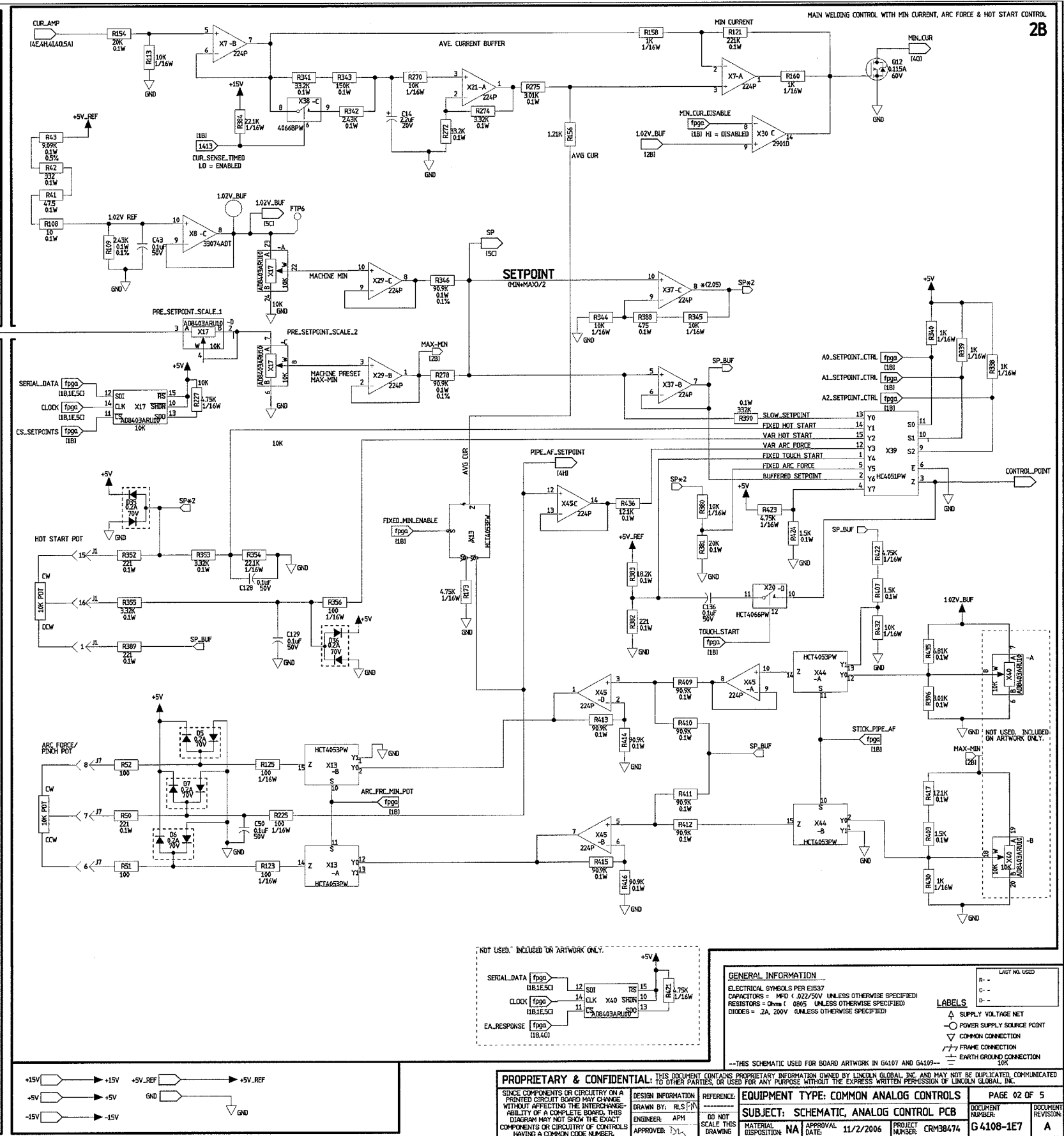
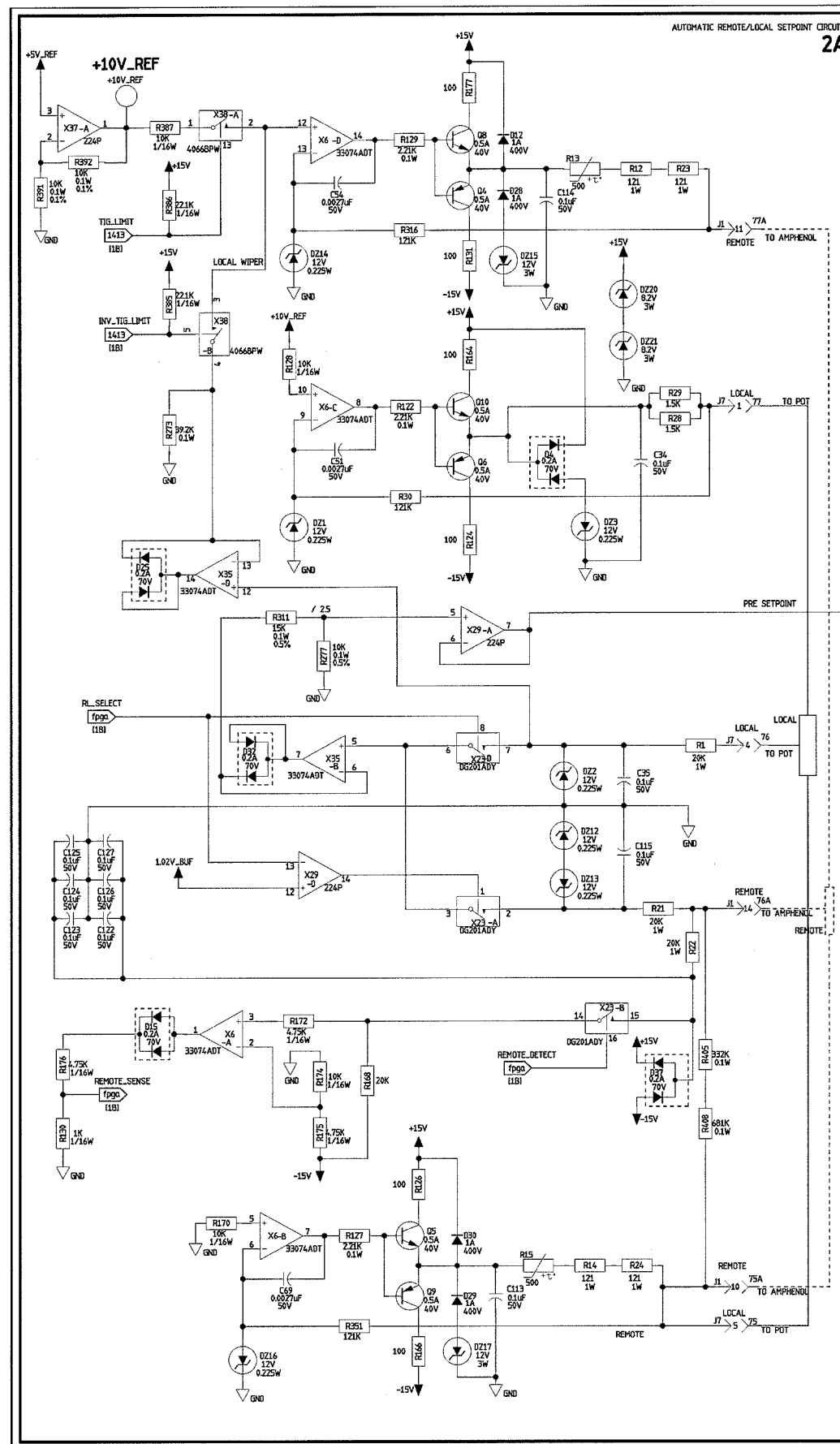
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GENERAL INFORMATION		LABELS	
ELECTRICAL SYMBOLS PER E137		△	SUPPLY VOLTAGE NET
CAPACITORS = MFD (0.22/50V UNLESS OTHERWISE SPECIFIED)		○	POWER SUPPLY SOURCE POINT
RESISTORS = OHMS (0.005 UNLESS OTHERWISE SPECIFIED)		▽	COMMON CONNECTION
DIODES = 2A, 200V UNLESS OTHERWISE SPECIFIED		□	FRAME CONNECTION
		⊥	EARTH GROUND CONNECTION

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DESIGN INFORMATION	REFERENCE:	EQUIPMENT TYPE: COMMON ANALOG CONTROLS	PAGE 02 OF 5
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APPROVER: JYL	DO NOT SCALE THIS DRAWING	MATERIAL DISPOSITION: NA	REVISIONS
		APPROVAL DATE: 11/2/2006	PROJECT NUMBER: CRM38474
			G 4108-1E7
			A

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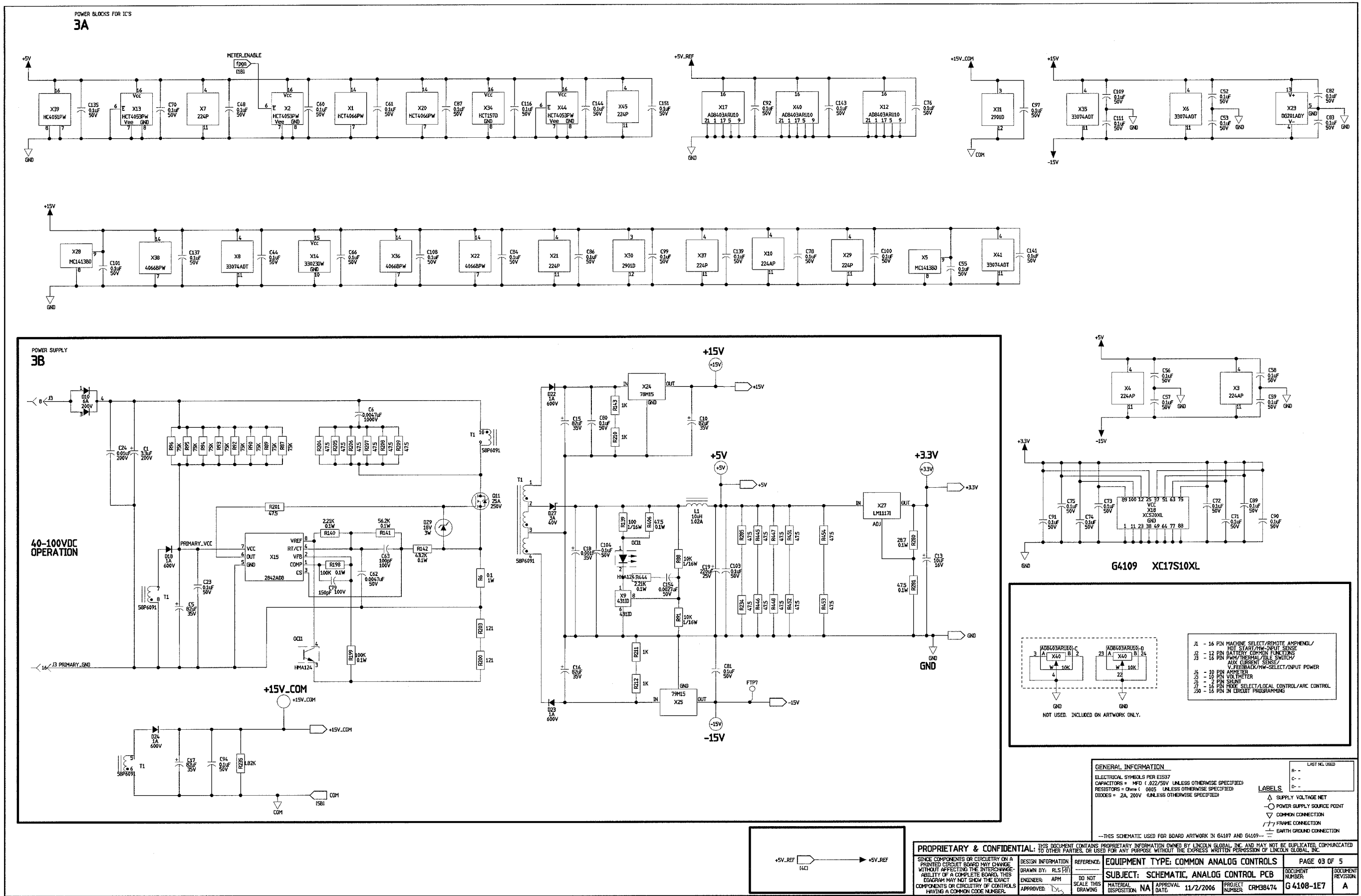
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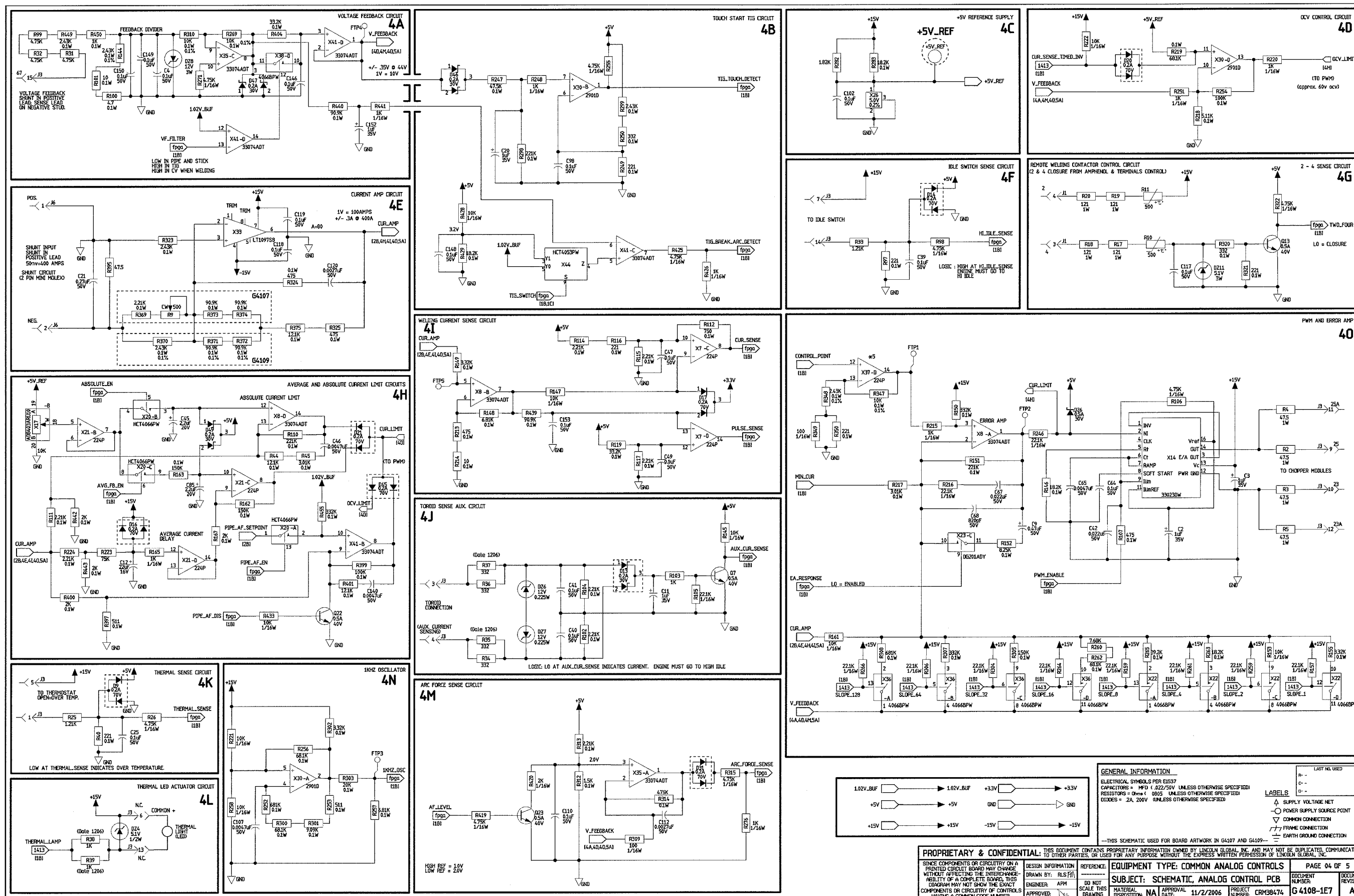
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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



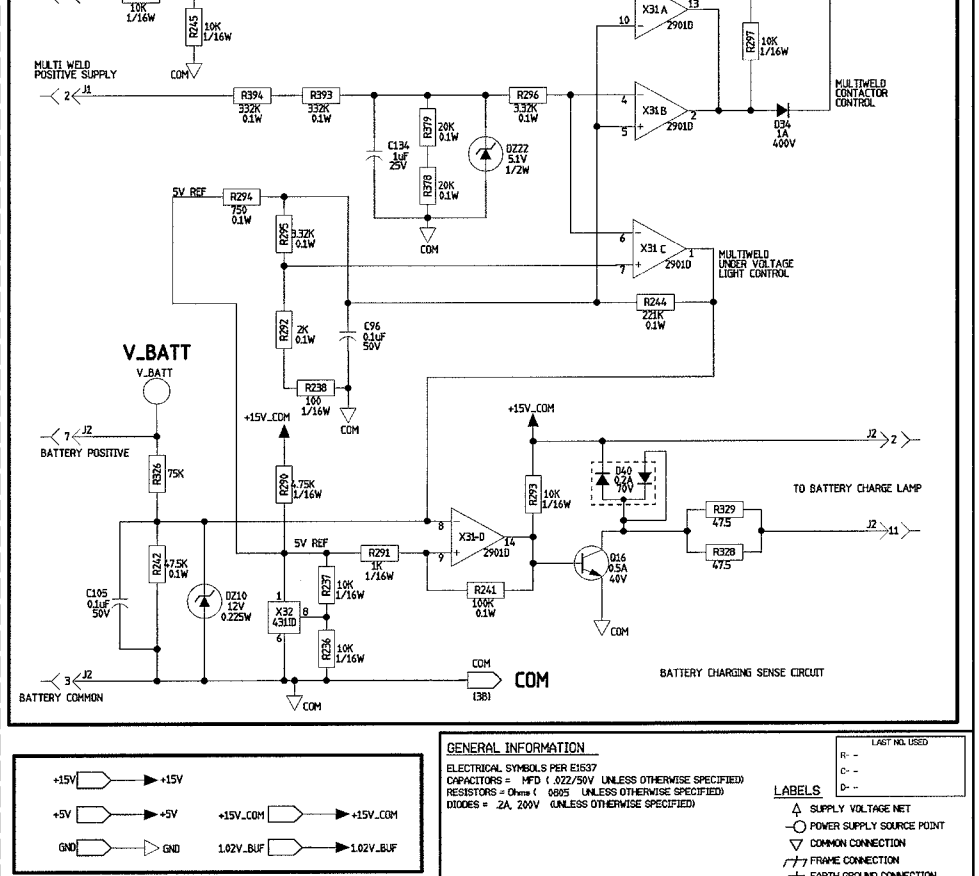
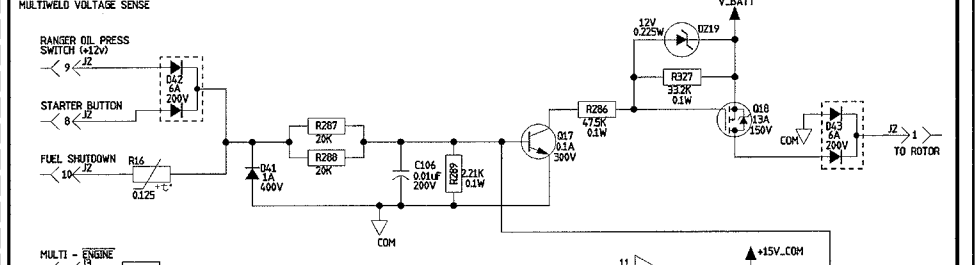
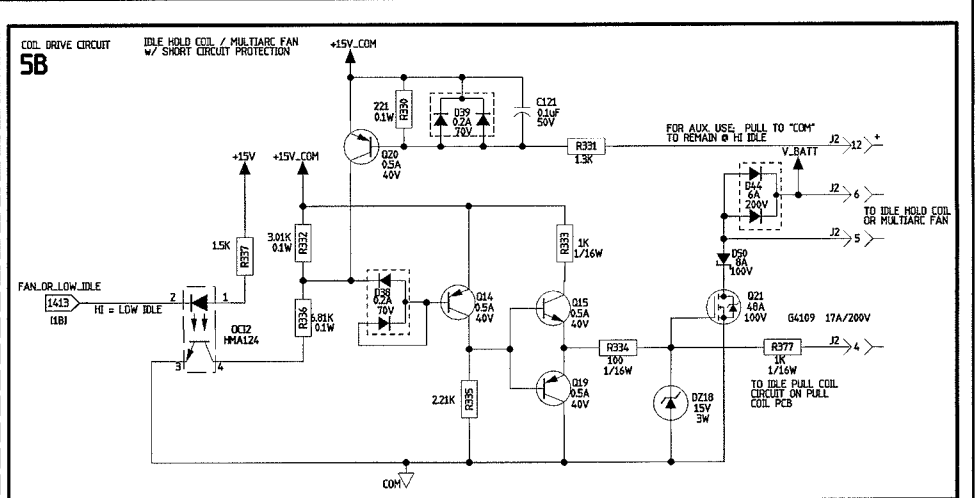
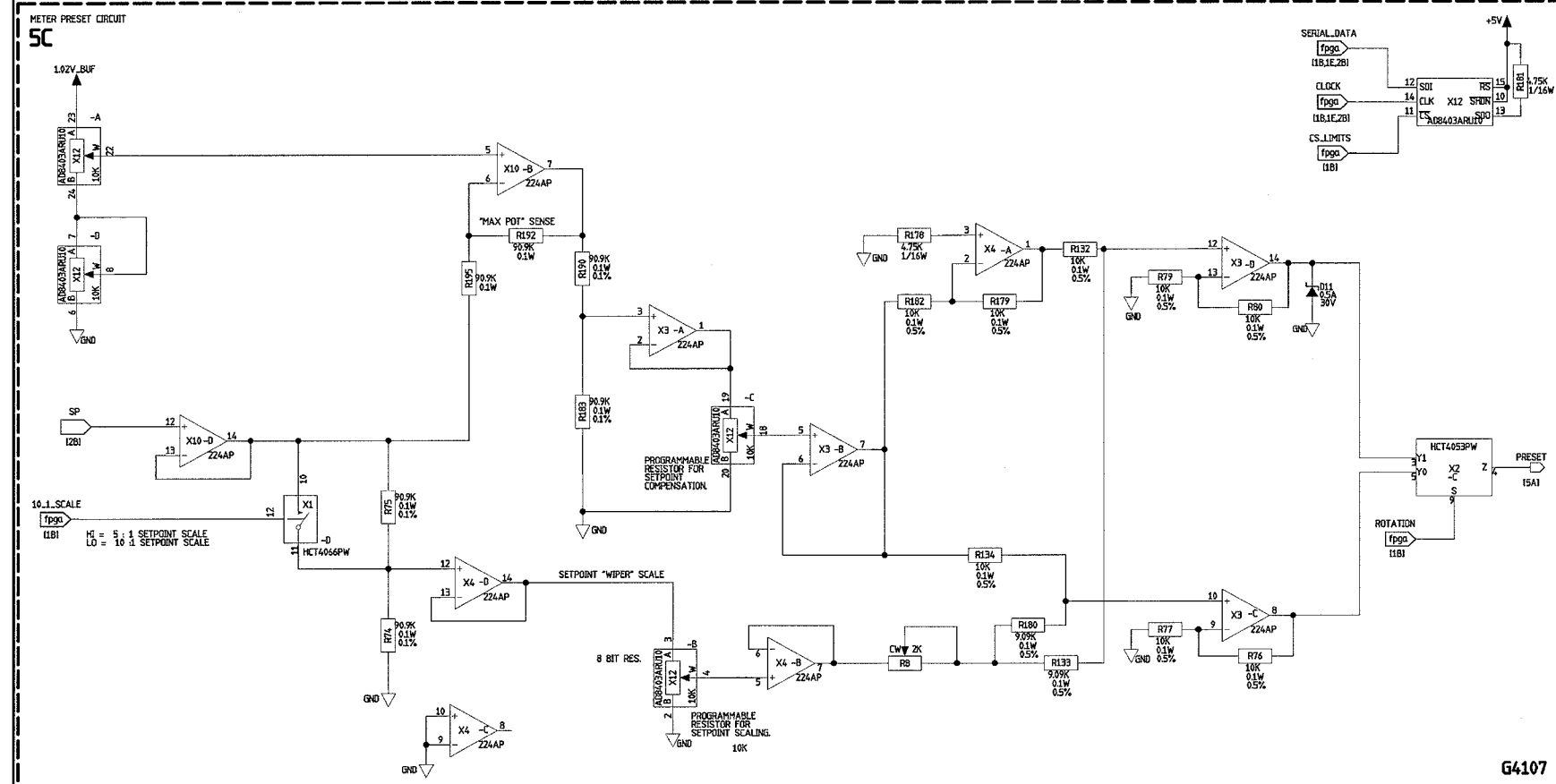
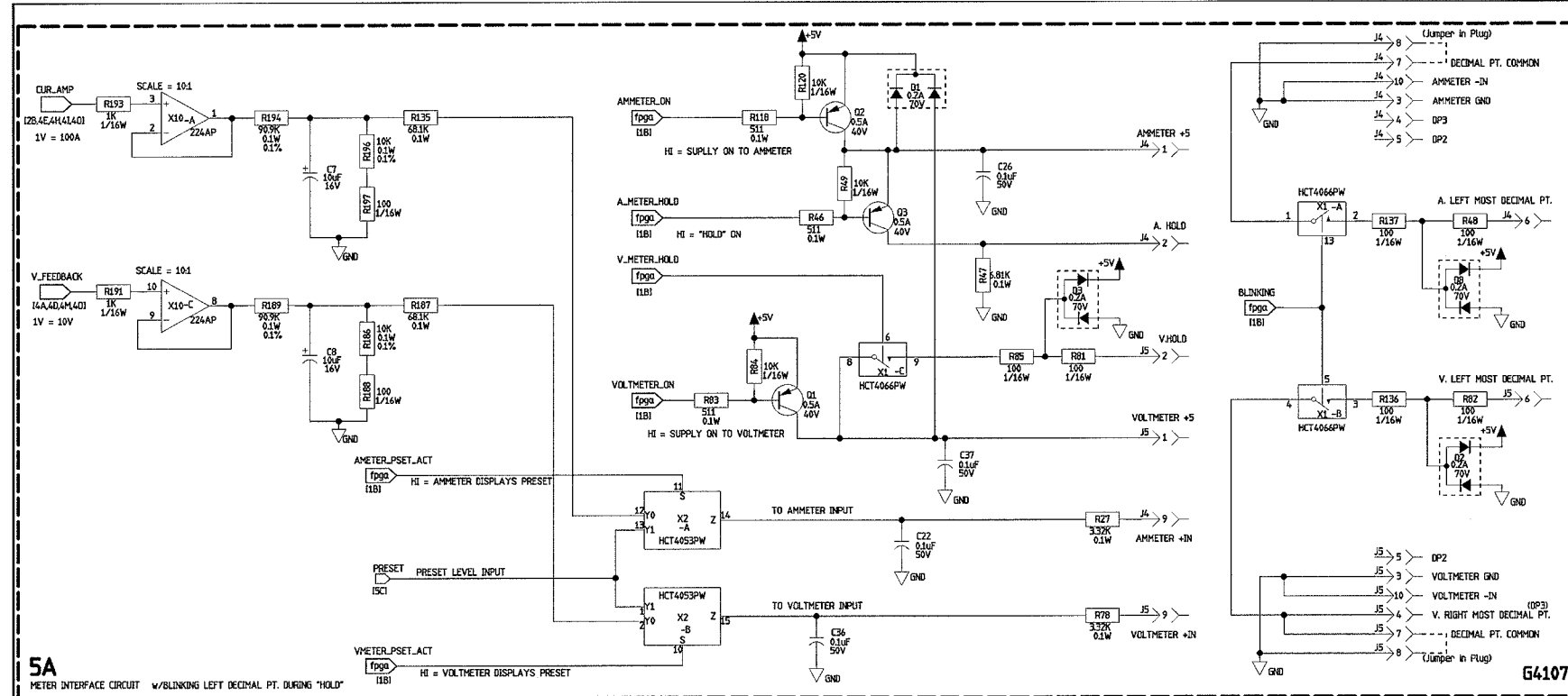
SCHEMATIC - WELD CONTROL PC BD - ALL CODES (G4108-1) PG 5 OF 5

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC



GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
 CAPACITORS = MFD (322/50V UNLESS OTHERWISE SPECIFIED)
 RESISTORS = OHMS (UNLESS OTHERWISE SPECIFIED)
 DIODES = 2A, 200V (UNLESS OTHERWISE SPECIFIED)

LEGEND

- SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- FRAME CONNECTION
- ⊥ EARTH GROUND CONNECTION

---THIS SCHEMATIC USED FOR BOARD ARTWORK IN G4107 AND G4109---

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DESIGN INFORMATION: EQUIPMENT TYPE: COMMON ANALOG CONTROLS
 DRAWN BY: RLS/ML
 ENGINEER: APM
 APPROVED: [Signature]

REFERENCE: SUBJECT: SCHEMATIC, ANALOG CONTROL PCB
 DO NOT SCALE THIS DRAWING
 MATERIAL DISPOSITION: NA
 APPROVAL DATE: 11/2/2006
 PROJECT NUMBER: CRH38474

PAGE 05 OF 5
 DOCUMENT NUMBER: G4108-1E7
 REVISION: A

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.



PC BOARD ASSEMBLY - WELD CONTROL PC BD - ALL CODES (G4107-1)

L-2014D

ENGINEERING CONTROLLED CHANGE DETAIL: REMOVED J50 AND R1V SEALANT WITH NOTE N.K. REVISION BUY AS PART NUMBER, IDENTIFICATION CODE AND SCHEMATIC REFERENCE MANUFACTURER: Y68

NOTES:

- N.A. CAUTION: THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2464 BEFORE HANDLING.
N.B. PLACE CONNECTOR KEYING PLUGS, OVER HEADER PIN, IN LOCATION SHOWN. PLUG SHOULD BE INSERTED BELOW CONNECTOR TOP SURFACE (2 PLACES).
N.C. SECURE P.C. BOARD ASSEMBLY IN PLACE WITH ITEM (4). (2 PLACES, 5.3 +/- .5 IN. LBS).
N.F. PLACE BARCODED ASSEMBLY NUMBER IDENTIFICATION AND BARCODED SERIAL NUMBER IDENTIFICATION IN AREA SHOWN.
N.G. PROGRAM ITEM (141) WITH ITEM (7).
N.H. PROGRAM ITEM (145) WITH ITEM (8).
N.J. PARTS SHOWN MUST BE COMPLETELY COVERED WITH ENCAPSULATION.

P.C. BOARD BLANK INFORMATION BUY COMPLETE AS G4107-E (6 LAYER BOARD PER E3867) SEE ELECTRONIC FILE FOR INFORMATION

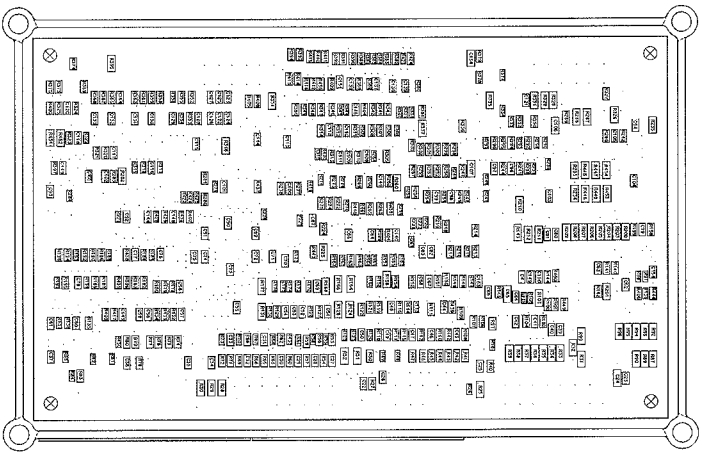
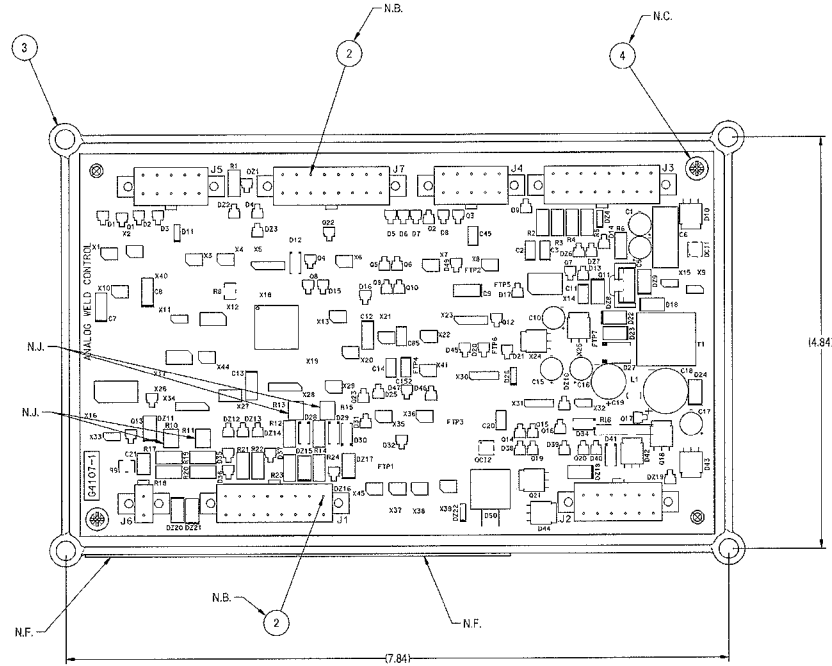


Table with columns: ITEM, PART NO., QTY., P.C. BOARD REFERENCE DESIGNATIONS, DESCRIPTION. Lists various electronic components like resistors, capacitors, diodes, and connectors.

Table with columns: ITEM, PART NO., QTY., P.C. BOARD REFERENCE DESIGNATIONS, DESCRIPTION. Continuation of the parts list from the previous table.

NOTE: G4109-1 & G4461-1 MUST BE REVIEWED WHEN MODIFYING THIS BOARD.



PART NO. IDENTIFICATION CODE

UNLESS OTHERWISE SPECIFIED: RESISTANCE = OHMS SCHEMATIC REFERENCE G4108-1E7 BUY PER E3867 TEST PER E4048

Table with columns: PROPRIETARY & CONFIDENTIAL, DESIGN INFORMATION, REFERENCE, EQUIPMENT TYPE, COMMON ANALOG CONTROL, PAGE 1 OF 1, DOCUMENT NUMBER, WELD CONTROL PCB ASSEMBLY, DOCUMENT REVISION, G4107-1, H

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. Individual Printed Circuit Board Components are not available from Lincoln Electric. This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



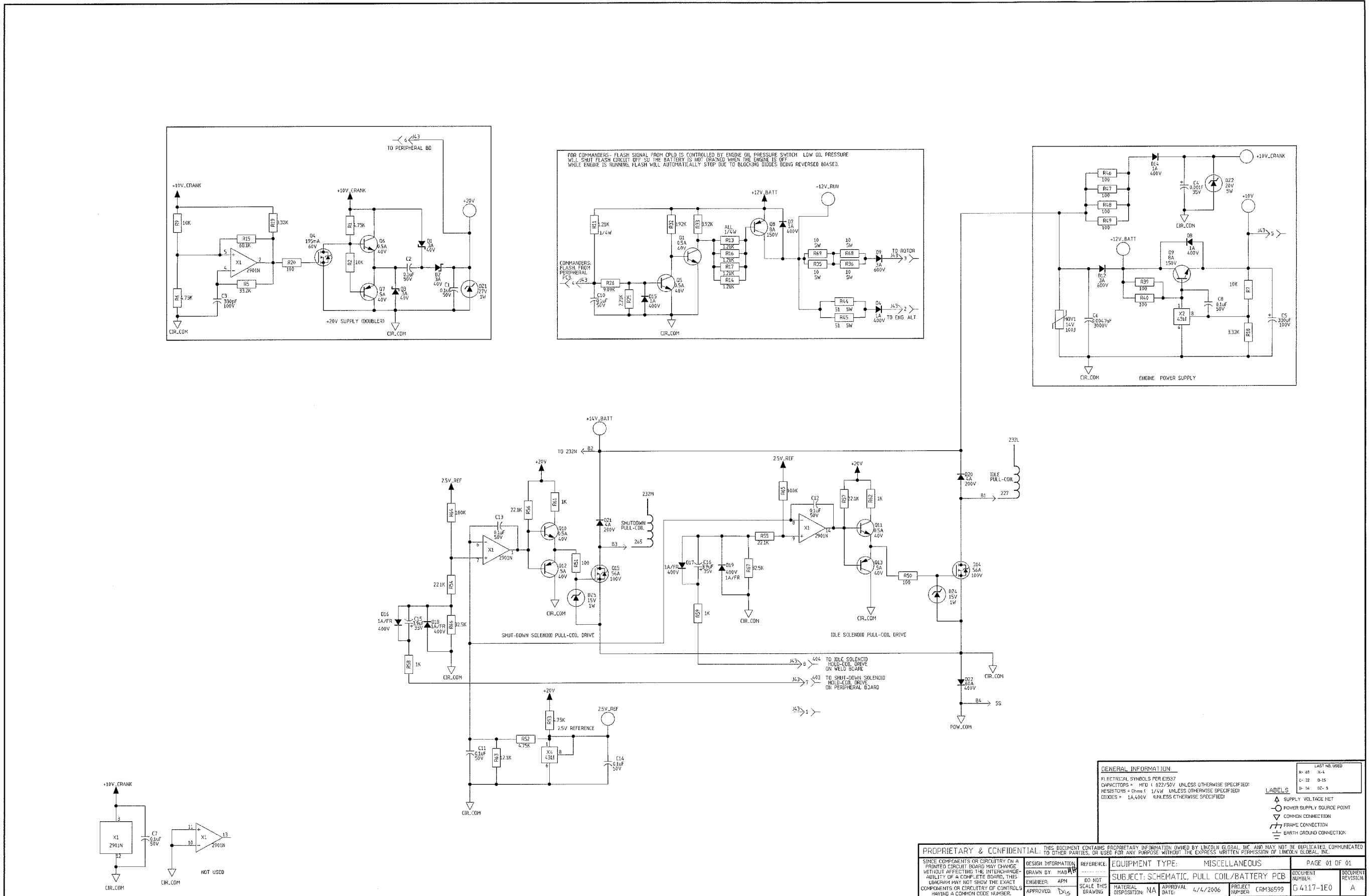
SCHEMATIC - PULL COIL PC BD - ALL CODES (G4117-1)

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

PC BOARD ASSEMBLY - PULL COIL PC BD - ALL CODES (L11768-1)

L-892117	ENGINEERING CONTROLLED MANUFACTURER: Yes	CHANGE DETAIL: UPDATED COMPONENT DESIGNATORS	
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P.C. BOARD BLANK INFORMATION
 MAKE FROM S19399 (MAKES 10 BOARDS PER PANEL)
 SEE ELECTRONIC FILE FOR ADDITIONAL INFORMATION

BLANK PART NUMBER - L11768-E

DESIGNATOR	REQ'D	PART NO.	DESCRIPTION
B1, B2, B3, B4	4	T13157-24	CONNECTOR, TAB, Q.C. VERTICAL, 1/4, EXTENDED
C1, C2, C7, C8, C10, C11, C12, C13, C14	9	S16668-11	CAPACITOR, CEMO, 0.1, 50V, 10%
C3	1	S16668-8	CAPACITOR, CEMO, 330p, 100V, 5%
C4	1	S13490-179	CAPACITOR, ALEL, 1000, 35V, 20%
C5	1	S13490-184	CAP. ALEL, 330, 100V, 20%
C6	1	T11577-58	CAPACITOR, CD, .0047, 3000V, 20%
C15, C16	2	S13490-69	CAPACITOR, TAEI, 3.9, 35V, 10%
D1, D2, D3	3	T12705-37	DIODE, SCHOTTKY, AXLDS, 3A, 40V
D4, D7, D8, D14, D15	5	T12199-1	DIODE, AXLDS, 1A, 400V
D9, D12	2	T12705-29	DIODE, AXLDS, 3A, 600V, 1N5406
D16, D17, D18, D19	4	T12705-34	DIODE, AXLDS, 1A, 400V, FR, 1N4936
D20, D21	2	T12705-47	DIODE, AXLDS, 4A, 200V, UFR
D22	1	T12705-52	DIODE, T218, 60A, 400V, SR
DZ1	1	T12702-26	ZENER DIODE, 1W, 27V, 10% 1N4750A
DZ2	1	T12702-25	ZENER DIODE, 5W, 20V, 5% 1N5357B
DZ4, DZ5	2	T12702-29	ZENER DIODE, 1W, 15V, 5% 1N4744A
J43	1	S24020-8	CONNECTOR, MOLEX, MINI, PCB, 3-PIN, TIN
MOV1	1	T13640-26	MOV, 14VRMS, 100J, 20MM
Q1, Q5, Q6, Q10, Q11	5	T12704-68	TRANSISTOR, NPN, TO226, 0.5A, 40V, 2N4401
N.A. Q4	1	T12704-52	TRANSISTOR, NMF, TO226, 195A, 60V, BS170 (SS)
Q7, Q12, Q13	3	T12704-69	TRANSISTOR, PNP, TO226, 0.5A, 40V, 2N4403
Q8	1	S18395-40	TRANSISTOR, P, T220, 8A, 150V, MJE15031 & S20590-2HS
Q9	1	S18395-39	TRANSISTOR, N, T220, 8A, 150V, MJE15030 & S20590-2HS
N.A. Q14, Q15	2	S18395-44	MOSFET/HEATSINK ASBLY, T12704-97&S18104-3 (SS)
R1, R6, R52, R53	4	S19400-4751	RESISTOR, MF, 1/4W, 4.75K, 1%
R2, R7, R9	3	S19400-1002	RESISTOR, MF, 1/4W, 10.0K, 1%
R5	1	S19400-3322	RESISTOR, MF, 1/4W, 33.2K, 1%
R11, R13, R14, R16, R17	5	S19400-1211	RESISTOR, MF, 1/4W, 1.21K, 1%
R15	1	S19400-6812	RESISTOR, MF, 1/4W, 68.1K, 1%
R18, R19	2	S19400-3321	RESISTOR, MF, 1/4W, 3.32K, 1%
R20, R36, R40, R46, R47, R48, R49, R50, R51	9	S19400-1000	RESISTOR, MF, 1/4W, 100, 1%
R25	1	S19400-2211	RESISTOR, MF, 1/4W, 2.21K, 1%
R26	1	S19400-9091	RESISTOR, MF, 1/4W, 9.09K, 1%
R32, R33	2	S19400-3921	RESISTOR, MF, 1/4W, 3.92K, 1%
R35, R36, R38, R69	4	S25365-10R0	RESISTOR, STAND-UP, WWW, 5W, 10.0, 5%
R44, R45	2	S25365-51R0	RESISTOR, STAND-UP, WWW, 5W, 51.0, 5%
R54, R55, R56, R57	4	S19400-2212	RESISTOR, MF, 1/4W, 22.1K, 1%
R58, R59, R61, R62	4	S19400-1001	RESISTOR, MF, 1/4W, 1.00K, 1%
R63	1	S19400-1212	RESISTOR, MF, 1/4W, 12.1K, 1%
R64, R65	2	S19400-1003	RESISTOR, MF, 1/4W, 100K, 1%
R66, R67	2	S19400-6252	RESISTOR, MF, 1/4W, 62.5K, 1%
X1	1	S15128-11	IC, COMPARATOR, QUAD, 2901N
X2, X4	2	S15128-10	VOLTAGE REF, ADJ, PRECISION, 4311

ITEM	PART NO.	QTY	DESCRIPTION
1	SEE BLANK INFO	1	PCB BLANK
2	M19436-3	1	POTTING TRAY
3	S8025-80	2	SELF TAPPING SCREW
4	E2527	112 g	EPOXY ENCAPSULATING RESIN
5	E3539	AS REQ'D	ELECTRICAL INSULATING COMPOUND

NOTES:

N.A. **CAUTION:** THIS DEVICE IS SUBJECT TO DAMAGE BY STATIC ELECTRICITY. LINCOLN ELECTRIC TO SEE E2454 BEFORE HANDLING.

N.B. SECURE P.C. BOARD ASSEMBLY IN PLACE WITH ITEM (4), 2 PLACES.

N.C. PRINT L11768-1 (LATEST DASH NUMBER AND I.D. CODE) ON LABEL.

N.E. PART MAY TILT ± 10° FROM PERPENDICULAR TO THE BOARD.

N.F. ENCAPSULATE PER E1911-E TO MIN. DEPTH, SUCH THAT ALL COMPONENT LEADS ARE COVERED.

N.G. ALL CONNECTORS MUST BE GREASED WITH ITEM 5 PRIOR TO COATING.

MAKE AS

L11768-1E0

PART NO. IDENTIFICATION CODE

PER E1911

TEST PER E4050

SCHEMATIC REFERENCE G4117-1E0

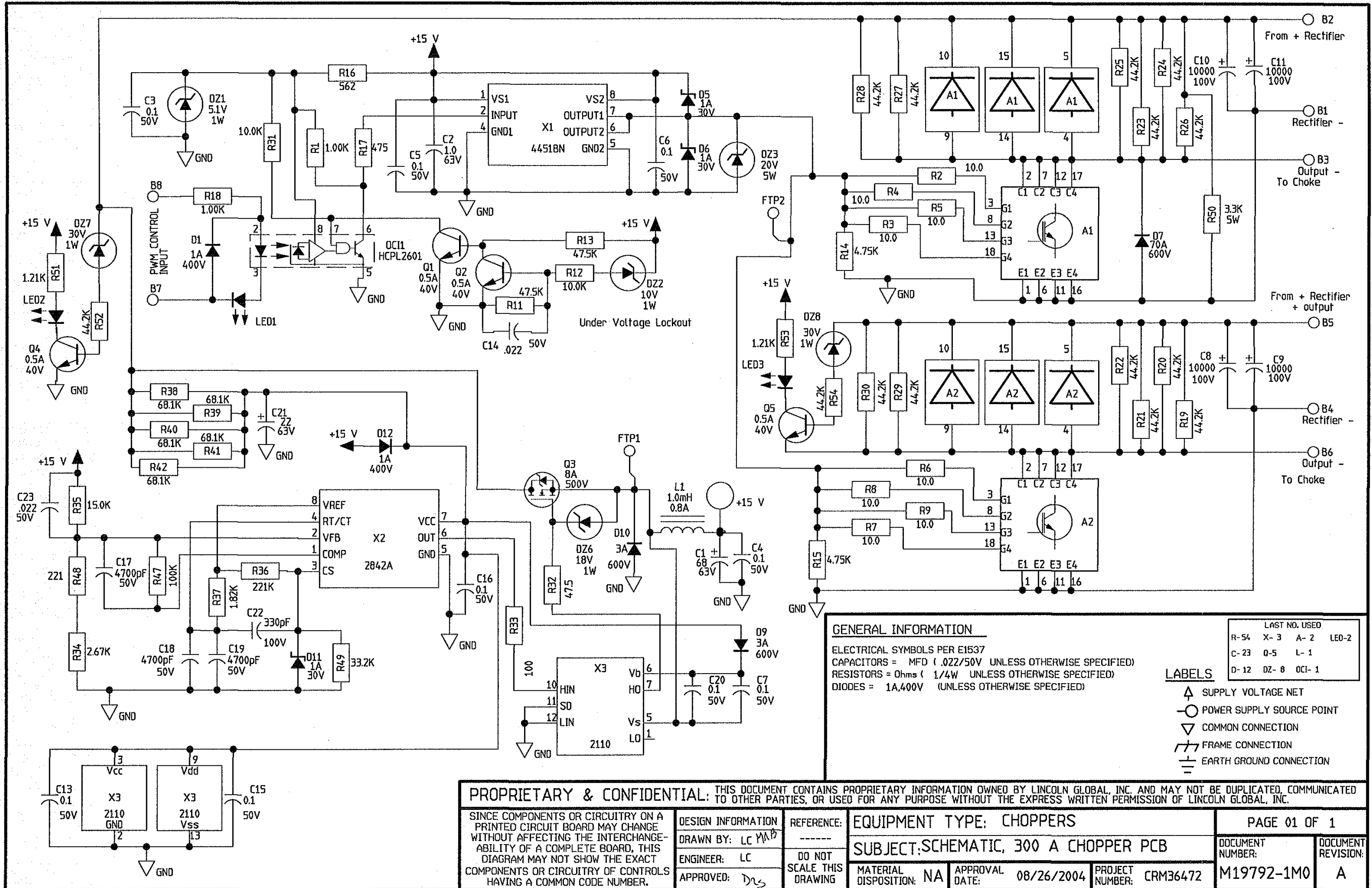
UNLESS OTHERWISE SPECIFIED:
 CAPACITORS = MFD/VOLTS
 RESISTORS = 1/4W/OHMS
 INDUCTANCE = HENRYS

Return to Section TOC

NOTE: Lincoln Electric assumes no responsibility for liabilities resulting from board level troubleshooting. PC Board repairs will invalidate your factory warranty. Individual Printed Circuit Board Components are not available from Lincoln Electric. This information is provided for reference only. Lincoln Electric discourages board level troubleshooting and repair since it may compromise the quality of the design and may result in danger to the Machine Operator or Technician. Improper PC board repairs could result in damage to the machine.



SCHEMATIC - CHOPPER PC BD - ALL CODES (M19792-1)



GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
 CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
 RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
 DIODES = 1A,400V (UNLESS OTHERWISE SPECIFIED)

LAST NO. USED

R-54	X-3	A-2	LED-2
C-23	0-5	L-1	
D-12	DZ-8	OCI-1	

LABELS

- ▲ SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- ▽ COMMON CONNECTION
- ▬ FRAME CONNECTION
- ⊥ EARTH GROUND CONNECTION

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DESIGN INFORMATION	REFERENCE:	EQUIPMENT TYPE: CHOPPERS	PAGE 01 OF 1
DRAWN BY: LC	-----	SUBJECT: SCHEMATIC, 300 A CHOPPER PCB	DOCUMENT NUMBER: M19792-1M0
ENGINEER: LC	DO NOT SCALE THIS DRAWING	MATERIAL DISPOSITION: NA	DOCUMENT REVISION: A
APPROVED: <i>Drs</i>		APPROVAL DATE: 08/26/2004	PROJECT NUMBER: CRM36472

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

